POPULAR SCIENCE

FOUNDED MONTHLY

MAY · 1931
25 CENTS

"SPINNER PLANE"
Newest Idea In Aviation
PAGE 28

Are you paying 6.7¢ for ten hammer blows?

Startling facts developed through tests by the New York State Department of Labor show, not only the high cost, but the actual danger of using cheap tools.

DURING an investigation into the causes of accidents, a hammer test was made by Dean Bliss of New York University. A special machine reproduced the repeated blows to which a hammer may be subjected.

With a cheap hammer, the head flew off after fifteen blows. The cost for ten blows was 6.7c.

Tests of good hammers indicated an average of 7,000 blows. Four hundred and sixty-six times the efficiency! And little risk from chipping faces or flying heads.

The Bulletin on "Hand Tool Accidents" issued by New York State Department of Labor further states: "This example has dealt with the poorest and the best hammer. Between these extremes are the thirty-five to seventy-five cent hammers that some mechanics do buy. A carpenter's hammer of safe quality and assembly cannot be bought today for those prices."

For economy, efficiency and safety choose a Plumb Nail Hammer; with its broad face for greater accuracy; with its short neck for better balance; with the sharply-bent claws which give greater leverage; —with its vise-like grip that pulls the slimmest headless brad; with its hand-comfort, non-slip handle; with that famous safety feature — the Take-Up Wedge which keeps the handle tight, just by a turn of the screw.

Model H F 31, 1-lb. head, Price $1.50 at good hardware stores. Look for the Red Handle and Black Head.

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Philadelphia, U. S. A.

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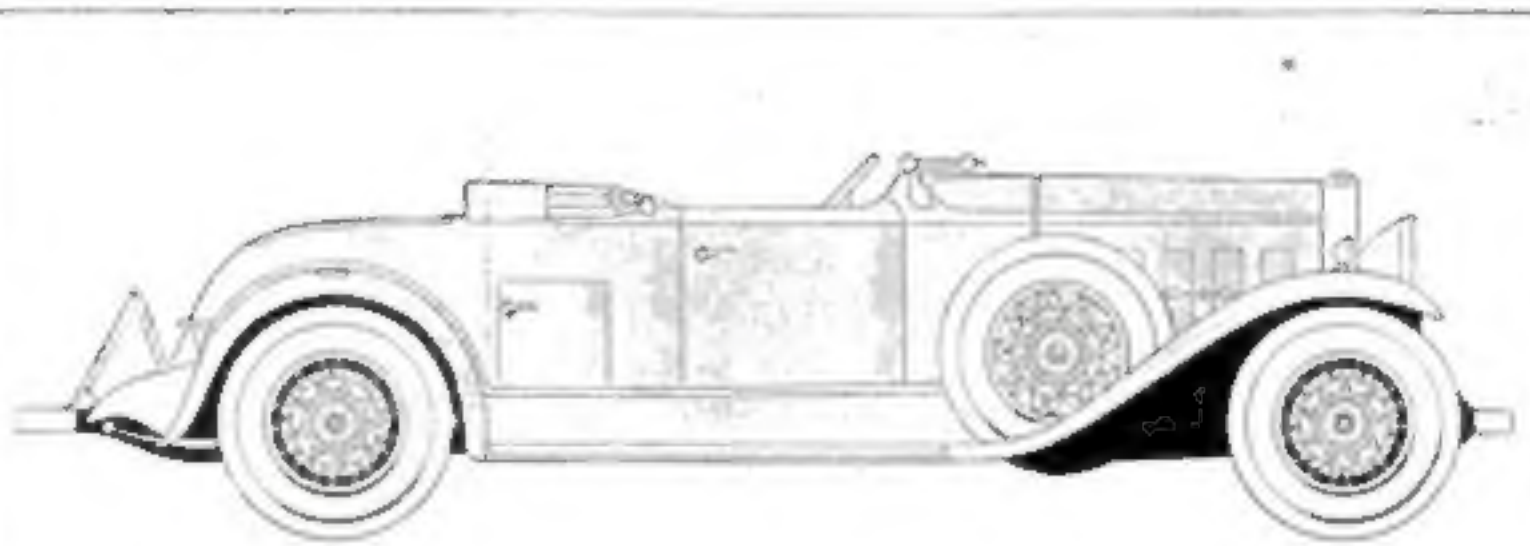
Vise-Like Grip
Nipper claws that grip and hold the slimmest brad.

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Even if LaSalle were stripped of those distinctive characteristics which brand it so unmistakably as an aristocrat among motor cars—one fact would still remain to proclaim it a superior automobile. LaSalle is built by Cadillac, and in every feature of its design and in every process of its manufacture, is held to the same high standards as Cadillac itself.

LA SALLE V-8



The new LaSalle V-8 applies to eight-cylinder design the significant advancements in engine, chassis and coachwork developed in creating the new V-8, V-12 and the V-16. Shown above is the LaSalle 2-Passenger Roadster, coachwork by Fleetwood. Price range, $2195 to $3245, f. o. b. Detroit. The liberal G. M. A. C. payment plan is recommended to all purchasers

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POPULAR SCIENCE MONTHLY

381 Fourth Avenue
New York, N. Y.

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Are Bank Stocks A Good Buy NOW?

By LEON MEADOW, *Financial Editor*

"SUPPOSE you tell us, Frank—you're the financier in this crowd. What would you advise a chap with $1,000 to invest his money in these days?"

Roger Blake put the question to him as he and John Fallon and Frank Dickinson were waiting one evening at the latter's house for Ernest Anderson to show up—so that the weekly bridge game could start. "It all depends" Dickinson replied, what he wants for his money—safety, profits, interest yield, and what percentage of each. Would he expect over-night success or is he willing to sit tight for a while?"

"Say," John Fallon broke in, "ease off that professional attitude! This fellow has $1,000. He wants a safe investment, normal yield, logical chances for profit. Something he can buy, put away, forget for 5 or 10 years, and then find that he has made a sound, profitable investment."

"That's more like it," replied Frank. "In the last few weeks any number of people have asked me for the same advice. I've recommended bank stocks."

"What!" John Fallon shouted, "Bank stocks!—with hundreds of banks failing throughout the country? How do you get that way?"

"Easy, John—wait until you hear the whole story. When I recommend bank stocks I'm talking about stocks of the leading, capably managed banks, preferably those operating in the largest cities in the country. A thorough investigation of the management, personnel and policies of a bank over a fair number of years should be sufficient guide in determining the honesty of its operations and the solidity of its structure. Don't take some of the sorrowful mistakes of the past year as examples. They are exceptions, and their failure can very decidedly be blamed upon improper management. Compared to the number of recent failures among large and supposedly solid commercial and industrial firms, the record of large and good banks is an enviable one. Now I'm getting warmed up to the subject," Dickinson continued, "so prepare yourselves for some 'tall' listening."

"If you're prepared," Blake interrupted, "to do some 'tall' convincing."

"I am. To begin with, bank stocks have never enjoyed the same widespread popularity as leading industrial, railroad and utility stocks. For one thing, few of them are listed on the big exchanges. Mostly, they're traded 'over-the-counter'—where the gap between bid and offered prices is larger. As a rule they can't be bought on margin like listed stocks, although they are accepted as good collateral by most banks. Also, their unit prices are often high, and for that reason they've been known as 'rich man's stocks'. In fact, they are largely held by wealthy investors."

"That should be enough to let us out," said John Fallon.

"On the contrary, Jack—in this case I think it's a point in favor of the average investor because it at least shows him that the bank stocks are most assuredly good investments. Otherwise they wouldn't be so popular with your wealthy investor, who is always on the lookout for securities of established safety that will prove profitable in the long run. There's no reason why the investor of smaller means can't follow the rich man's example and find the results just as profitable, on a smaller scale." He paused to light a cigarette, and Blake picked up the conversation.

"The trouble is, Frank, that the average investor knows little enough about industrial stocks—and when it comes to the complications of bank stocks he's completely at sea. I'm taking myself as an example."

"And I agree with him," Fallon added. "Analyzing the true value of bank stocks has always been an absolute mystery to me."

"If that's the case, then I'd better go deeper than I intended. First let me tell you about their advantages, and the factors that make them attractive. The banking business follows more closely than any other enterprise the general business development of the country. Almost every transaction expressed in monetary value has to be cleared and handled through a bank, directly or indirectly. The more complicated our economic structure becomes—and the tendency is certainly toward that in a progressive country like this—the more business there is for the banks, and the more sources of income are theirs. If you believe in the progressive attitude of this country's business men, if you appreciate the fact that its commercial and industrial structure is ever broadening, becoming more and more complex, looking increasingly to the banks for further support—and no sane man could believe otherwise—then it ought to be clear to you that banks and their capital stocks are without doubt among the finest investments there are on the long term basis. Bank clearings bear this out with their staggering totals of billions and billions, *consistently growing larger.*

"Now, to get off the 'soap-box' and become specific, banks derive their income from various sources. Loans made to governments, corporations and individuals at attractive rates; discounting of commercial paper and other forms of indebtedness; trust services; collections; syndicate operations and many other channels.

"If a bank shows a healthy rate of growth, as any well-managed bank in a good territory should, it soon becomes in need of additional working capital. Because of this, banks generally maintain a policy of distributing rather small dividends compared to what they actually earn. The earnings thus withheld are kept in the form of a surplus on which they draw—at least partially—for their needed, additional capital. But, offsetting the small dividend is the *(Continued on page 6)*

ARE BANK STOCKS A GOOD BUY NOW?

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fact that the value of the stock is increasing all the time because of the growing surplus. Often, however, this accumulation of capital funds is too slow to meet the bank's growing business needs. So, to increase their working capital, banks issue to their stockholders rights to subscribe to additional stock at very attractive prices, much below the current market value.

"For example, a bank whose stock is selling at 100 may give rights to its stockholders to purchase for each 4 shares held, 1 additional share at $60. The value of such a right would be about $10 and. . . ."

"Not so fast, Frank," interrupted John Fallon.

"Remember," added Blake, "you're the financier and we're starting from the ground up. How do you figure the value of that right at $10?"

"Easily enough," replied Dickinson. "The difference between that stock at its market price of 100 and the right at 60 is forty dollars. Divide that by your unit of 4 shares and the market value of the right becomes $10. If the holder doesn't want to put up additional money for new shares, he can dispose of that right on the open market for $10, or whatever the price happens to be. The value of such rights when added to the annual dividend makes the total return on bank stocks highly attractive. An average return of 10% in that way is not exceptional."

"Hold on," Roger interrupted, "how 10%?"

"Well—we'll say that this bank stock, selling at 100, pays an annual dividend of $4.—or 4%. Remember this is a leading, representative bank and, as such, would probably issue stock rights about every second year. As I showed you before, at $60 a right, that means a $10 market value over the two year period, or $5.00 a year. Add that to your 4% dividend and you have a total of 9% a year. Now you see why bank stocks can be so attractive. And now I'm getting a little hoarse. Think I'll run into the kitchen for some water and give you boys a chance to digest what I've said."

After a few minutes he returned and said: "I've just thought of some information I came across the other day. It should interest you. In 1919 a man bought 10 shares of stock in what is now one of the country's largest banks. He paid $610 a share, or $6100. Later in that year, rights were issued offering one new share at $150 for each two shares held. So this man bought 5 shares, costing $1750 and bringing his total to 15 shares, costing in all $7850. In 1921 rights, in the ratio of 1 to 3, at $225 a share were issued. By paying $1125 he added 5 more shares and brought his total up to 20 shares, costing in all $8975. In 1926 rights were issued again, 1 new share at $100 for each two held. So he bought 10 shares for $1000 and increased his holdings to 30 shares, costing $9535. In 1927 rights were issued, 1 share at 325 for each 3 held. By paying $1950 he received six more shares and brought his total up to 36 shares, costing $11,485. In 1928 rights were issued, 1 share at $400 for each 5 held. So he added 7-1/5th shares to his holdings—paid $3600 to do it—and thus raised the total to 43-1/5th shares, costing in all $15,085. In 1929 par was reduced from $100 to $20, and 5 new shares were offered at $110 apiece for each 4 shares held. The split-up in par increased his holdings 5 times over —to 216 shares. And then, by taking advantage of the 5 for 4 rights, he added 55 shares more at a cost of $6050. So his total was then 271 shares, costing $21,135. Later in 1929 a 125% stock dividend was declared—thereby giving him 34 shares more—to make a total of 325 shares in all.

"Now, here's the moral: At that time, in 1929, the stock was quoted at $260 a share. So his holdings were then worth $81,900. . .

"Yes, but you forget," interrupted Roger, "that that was at the very height of the market boom. What are those same 315 shares worth now?"

"I was coming to that," Frank replied. "As you say, that was at the height of things. Now, this same stock is quoted at about 105—making his 315 shares worth $33,075. I admit that 1929 values cannot be taken as a standard, but for exactly the opposite reason, 1931 values cannot be taken either. Let's reckon by normal times. Under average conditions, experience shows that a good bank stock should sell for about twice its book value. In this case, that is about $65 a share. So, assuming a normal price of $130 on the stock, that man's holdings would be worth $40,950—almost twice the total amount of his investment. Remember, all this happened in 12 years, and during all that time this man received his annual 4% dividend *(Continued on page 7)*

ARE BANK STOCKS A GOOD BUY NOW?

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regularly. What's more—this case is no exception. Over the same period of time, this growth was approximately as true for anyone of the 5 or 6 largest banks in the country.

"I don't say that the next 10 years holds the same golden promise in bank stocks as those last 10 did. But I do say this—that no single branch of industry can possibly offer anything near the appreciation in value bank stocks will continue to enjoy in these 10 years coming. The nature of our economic structure—as it continues to grow larger and more complex—gives the well-managed bank opportunities for expansion and profits that cannot be equalled in industry or commerce itself."

John Fallon, noting that Frank had finished, said. "That's really interesting, Frank, and there's no denying the truth of what you've said. But it all sounds too good—there must be a hitch somewhere."

"There are hitches to everything" Frank replied. "And bank stocks are no exception. In the marketing of these stocks, and in the fact that they are sold 'over-the-counter', the average investor encounters certain disadvantages. But they shouldn't amount to stumbling blocks if you follow these rules: First:—buy bank stocks only with the intention of holding them for several years. Then the slightly higher price paid for your shares on account of unlisted market conditions will be negligible compared to the probable appreciation of your holdings. Second—before placing a buying order, get the 'bid' and 'asked' prices of the stock and fix your price about halfway between those figures, preferably a little nearer the offering price. If the quotation reads 83-85, you should order the stock at 83½ or 84, not higher. Third—if rights are issued, use *them*, either by selling them or by subscribing to additional shares. Follow these rules and choose a large bank of unquestionable management and honesty—and then you can't go wrong over the long pull. Now let's play bridge." Frank concluded, as Ernest Anderson walked into the room.

To Help You Get Ahead

THE booklets listed below will help every family in laying out a financial plan. They will be sent on request.

"The Provident Provider" is a booklet describing a new savings plan which provides a regular retirement income for a man and insurance protection for his family. A copy will be mailed on request by Provident Mutual Life Insurance Company, Philadelphia, Pennsylvania.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

Enjoy Money shows how the regular investment of comparatively small sums under the Investors Syndicate plan, with annual compounding of 5½% interest, builds a permanent income producing estate, a financial reserve for a business, or a fund for university education or foreign travel. Write for this booklet to Investors Syndicate, Investors Syndicate Building, Minneapolis, Minnesota.

How to Retire in Fifteen Years is the story of a safe, sure and definite method of establishing an estate and building an independent income which will support you the rest of your life on the basis of your present living budget. Write for the booklet to Cochran & McCluer Company, 46 North Dearborn St., Chicago, Ill.

See How Easy It Is tells how it is possible to start off with a definite plan for creating an immediate estate leading to future financial security. Get your copy of this booklet by writing to Postal Life Insurance Company, 511 Fifth Avenue, New York City.

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POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use.

Tools, Radio Apparatus, Oil Burners and Refrigerators advertised in POPULAR SCIENCE MONTHLY have been tested or investigated by the Popular Science Institute of Standards and each advertisement carries the insignia indicating approval.

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THE PUBLISHERS

Chevrolet has more ball bearings than any other car at or near its price

1. Inner wheel bearing. 2. Outer wheel bearing. 3. Generator front end bearing. 4. Clutch pilot bearing. 5. Inner wheel bearing. 6. Outer wheel bearing. 7. Main drive gear thrust bearing. 8. Main drive gear radial bearing. 9. Differential bearing. 10. Differential bearing. 11. Axle shaft bearing. 12. Axle shaft bearing. 13. Clutch gear bearing. 14. Transmission drive shaft bearing. 15. Steering knuckle bearing. 16. Steering knuckle bearing.

Although the Chevrolet Six is one of the lowest priced of all cars, no expense or care has been spared to make it an unusually smooth running automobile. In its chassis there are more fine ball bearings than in any other car in America priced below $3000. Nothing rolls like a ball; and, therefore, a New Departure ball bearing is placed at every location where friction must be reduced to a minimum. No bearings are more accurately made, of finer, more costly, more enduring materials than New Departures. They are so designed as to assume naturally the loads and stresses of car operation—and at the same time transmit engine power with the least possible loss. They contribute smoothness, easy handling and alert response. And their extremely long life and freedom from repair or adjustment bring a minimum of upkeep to Chevrolet ownership. The liberal use of these fine ball bearings throughout the chassis of the new Chevrolet typifies the quality that exists in every part of this attractive low-priced Six. You will find that quality and great economy of operation mark Chevrolet as the Great American Value.

Chevrolet prices range from $475 to $650, f. o. b. Flint, Mich., Special Equipment Extra

Chevrolet Motor Company, Detroit, Michigan

NEW CHEVROLET SIX

The Great American Value

Build for Year-Round Comfort

Today's house can be so constructed that change in temperature will not be felt and home can be warm or cool as you wish

By
F. G. PRYOR
Secretary, Popular Science Institute

Snow and straw are fine insulators, and so these crude homes were really insulated against heat and cold, but of course not so well as is possible now with commercial material.

AT SOME time or another, most of us have had the misfortune to live in one of those sieve-like houses that are cold on frigid days, hot on torrid days, and generally receptive to all outdoor changes. Fortunately, however, there are not many houses of this sort going up today, for good building practice now calls for construction that permits temperature control twenty-four hours a day throughout the year

This new comfort is made possible through the use in roof and walls of a suitable layer of insulation which cuts down heat leakage to a minimum. It used to be that only refrigerator manufacturers and cold storage houses made practical use of insulating material but, when POPULAR SCIENCE INSTITUTE recently questioned 5000 leading architects and builders of homes on the subject, they were practically unanimous in declaring that insulation was as essential to the modern house as a heating plant

The practice of insulating dwellings is not only the outcome of the present demand for comfort but it has come about, also, as a result of the increased price of fuel. Heating costs have risen to a point where it is simply too expensive to heat half of the outdoors along with one's house as our fathers and grandfathers did in an attempt to keep their leaky structures warm.

It has been conservatively estimated that as much as $450 000 000 has been wasted annually in fuel in the United States because of poor or unscientific construction of home walls and roofs, and it is natural that there should be an effort toward stopping this leakage of millions of dollars' worth of heat

With insulation a decided cut in heating cost is possible and this, coupled with the comfort afforded, makes it seem not unreasonable to invest an extra two percent or so in building in order to get an insulated home. The reduction in heating cost is effected in two ways. In the first place, a smaller heating system can be used in an insulated dwelling than in a house that is not insulated since it is not alone the size of a house that determines the size of its heating plant but rather the amount of heat lost from the building

Cutting thirty percent off invested capital for radiators and boiler, as is frequently possible, goes a good way toward paying off the cost of insulating. Then, with a twenty to forty percent saving every year on fuel, it means that the insulation will not only soon pay for itself but before long will afford real dividends in money as well as in comfort

THE comfort to be had in an insulated house is an all-year advantage, but is particularly noticeable in the winter Once the furnace sends up heat, the heat stays within the house, sudden drops in outside temperature are scarcely felt inside, and the heating worries and constant furnace attendance that usually accompany a change in weather conditions are avoided. The owner of such a house finds it a decided relief to be able to leave his fire checked and go out, all with the comfortable assurance that the house will be warm when he returns despite any drop in outside temperature

In summer, the hot rays of the sun have a hard time getting into the insulated dwelling, and we do not find the temperature of such a house rising with the sun as it has a way of doing in homes that lack this special protection. It has been found possible in well insulated dwellings to keep upstairs rooms ten to fifteen degrees cooler than the outside temperature. Particularly is insulation appreciated in rooms directly under the roof, which are ordinarily unbearable on hot nights.

CONSIDERING these advantages, as well as lesser ones not enumerated, insulation is a feature of modern construction that the home builder or man who is modernizing his house will want to investigate. A number of good insulating materials are available which, properly applied, will do away with many of the unpleasant features of houses built before the present era of scientific construction. Readers who want full details on insulation, description of materials with their ratings, and general advice on the subject will be helped by a booklet entitled "Insulation in Building Construction" which can be had by sending twenty-five cents to the POPULAR SCIENCE INSTITUTE, 381 Fourth Ave., New York, N. Y

INSTITUTE BULLETINS

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Insulation in Building Construction*
List of Approved Tools
List of Approved Radio Sets
List of Approved Oil Burners
Advice on Installing Oil Heat
Refrigeration for the Home*

*Starred bulletins 25 cents

Our Readers Say

Don't You Know Chemistry When You See It?

AFTER looking over a few back copies of POPULAR SCIENCE MONTHLY, I found that there was not a single article on chemistry in them. Each of these issues seemed to be about ninety percent aviation and about ten percent shop. Personally I am interested in aviation, but POPULAR SCIENCE MONTHLY is getting to be more air-minded than science-minded. I know that chemistry is one of the sciences, but I don't know how popular it is. I enjoyed the article on the Goodyear Zeppelin, and if you must print aviation make it as interesting as that.—J. D. McPh., Birmingham, Ala.

The Electric Belt Makes Radio Debut

I HAVE spent the morning reading your magazine, especially that article on Uncle Sam Exposes Fake Cures. Some time ago your magazine published several fake exposes. One I remember dealt with an electric belt which was supposed to cure almost everything. From the description you gave at that time, I have identified a device now sold in this state, and advertised over the radio. I thought a timely warning in your magazine might save some of your newer readers from being duped.—W. S. I., Grafton, N. D.

Taking the Sting Out of the Kicks

I AM mostly interested in the Home Workshop and furniture building. Gus Wilson also is great, but there isn't any part of the magazine of which one could say it doesn't interest anybody. Even your advertisements are so arranged that one must at least glance at them in turning the pages over.—J. V. C., Lansford, Pa.

Can You Help Him With His Corks?

I HAVE been a reader of your very interesting monthly for some time past and naturally turn to you for a solution to a problem in physics which confronts me. If you take a small container about three inches in diameter, fill with water (not quite full), and place therein a cork or other buoyant article, you will find that the floating article is perceptibly attracted to the side of the vessel. Again, two buoyant articles placed about an inch apart in a larger water-filled vessel are attracted one to the other. Would appreciate it if you would tell me the name of the force that causes this attraction and also if you know of any book or article dealing with this force? Might say that I have conducted many experiments along this line.—P. D. B., Vancouver, Can.

Who Are You, And Where, Please?

PLEASE listen to my small kick—small but bitter. It's many a long day since my company first started advertising in POPULAR SCIENCE MONTHLY. That part's all right. It pays. But what I'm grouching about is this. When readers write in for further information about our products and seem anxious to find out all they can about them, why don't they sign their full names and addresses? And why don't they write the name and address so they can be read? Some even send money, ordering goods from us and neglect to tell us who they are and where they live. Naturally we can't fill such orders. A little item in the "Our Readers Say" department might have some effect in fixing this and that'll make things better for all of us. Don't you think so?—J. R. G., Philadelphia, Pa.

Here's an Idea to Save the Patent Office

SEVERAL months ago you ran some articles on our Patent Office difficulties that were a revelation and a cause for speculation as to remedies. One occurred to me that might be of some value. Let the person with what he thinks is a practical idea put it into working form. Afterwards a photograph should be taken of it with, say, leaves or grass, or anything of a nature that an artist could not duplicate showing in the background. This would prove that it actually existed. Then this photograph is sent to you for publication as a notice to the public that such a contrivance was built at least some days prior to the publication thereof and inviting anyone concerned to submit proof that they have anything of like nature of an earlier date. Of course the sender would also apply for a patent but I believe the real value would lie in the publishing of the photograph, as it would establish prior rights if no other existed and at the least would give litigants a chance to thrash out misunderstandings before costly patent expenses piled up. It seems to me that this would save the Patent Office untold labor and might enable it to catch up with its work. And that, you'll agree, is a consummation devoutly to be wished.—F. J. C., Medford, Ore.

Submerged Rock Hereby Acquitted

IN ANSWER to E. A. D., of Gorham, N. H., regarding your query of the upward pressure of the water causing a submerged rock to lose weight, which you originally addressed to M. J. K. The loss of weight in the rock when it is submerged in water is not an actual loss, but only an *apparent* one. To further illustrate this let us say you suspend a rock, attached to a balance, in water, first, however, having weighed the rock in air. You must be careful that the submerged rock does not touch any object, and that the balance is above water. You will then find that the balance registers a weight less than the weight of the rock in air. This *apparent* loss of weight of the rock is no doubt due to the upward pressure of the water.—S. W., New York, N. Y.

The Artist Insists This Man's All Wrong

I WONDER how many have noticed "What's wrong in this picture?" on the front cover of the February number of POPULAR SCIENCE MONTHLY. In the first place, as drawn, the footrest could not have a clearance of more than two inches on the level. Certainly the rider could not have come to his position amid the rocks in the orthodox manner. Second, should the driving mechanism happen to come onto a slight forward-slanting place the driver would be unseated by having the suitcase behind him jab him about the belt line. If these objections can be explained, let me know.—R. L. D., Hiram, Ohio.

Don't Let This "Simple" Problem Stop You

I WOULD like to submit a problem that is very catchy and yet is, on the whole, very simple—yet it will probably make some appeal to your readers. My only fear is that they will find it too simple to be interesting. However, here it is: A man is now twice as old as his wife was when he was as old as she is now. When she becomes as old as he is now the sum of their ages will equal one hundred.—C. C. W., Wichita, Kan.

Error Started Things In Distant Japan

THE faulty diction to which H. E. D. calls attention in a recent number of POPULAR SCIENCE MONTHLY is very common and is not practiced by the uninformed alone, but is gradually getting a place in the language by virtue of common usage. It has been said that in common usage the words "not only" should always be followed by "but also" though lately the "also" is being dropped by eminent writers. In the expression "but what" it is just possible that a "w" was substituted for the "t" to make the error, and sometimes even an omission can cause trouble. I wrote a formula for a trade paper once and the directions stated to boil a mixture to 330 degrees F. In the publication the "F" was omitted and some months later I received a letter from Japan

DANDRUFF BETRAYS YOU!

—get rid of it

ANNOYING unsightly unhealthy dandruff! how it repels others! How quickly it betrays you as a careless person!

Why put up with loose dandruff when full strength Listerine will stop it? *Thousands are enthusiastic about Lister ine used this way.*

Simply douse Listerine on the scalp full strength and massage vigorously. Within a day or two you ought to see marked improvement. Of course, if you have a severe infection, it will be necessary to keep Listerine on the scalp for several days. If your hair and scalp are excessively oily, use a Listerine shampoo.

Listerine removes dandruff scales from the scalp. Then it checks the scaling. And since dandruff is a germ disease, Listerine automatically checks any future infections that may be present. That is important because many dermatologists declare dandruff to be a germ disease.

Get a bottle of Listerine today and use it. See how much better your hair looks now—how much better your scalp feels tomorrow. Lambert Pharmacal Company, St. Louis, Mo., U. S. A.

LISTERINE

kills germs in fastest time
accurately recorded by science

Don't miss
BOBBY JONES, King of Golf
LISTERINE HOUR
Every Wednesday Night
WEAF and a coast to coast
NBC network
See your local paper for time

stating that there was something wrong with the imprinting as the process requires much fire engine, police, and excitement and distress of population." In the absence of the "F" the subscriber had used a "C" or centigrade thermometer.—C. L., Jersey City, N. J.

They Didn't Really Jump Over the Moon

In a recent issue of your magazine I found an article telling of cows that used a subway under a highway. That reminds me of an elevated crossing for the same purpose that I knew of some years ago. There was a dairy farm only a mile or so from the Richmond, Va., city limit. The hillside barn was separated from the pasture and by a railroad. One day the dairy herd and the locomotive reached the same spot at the same time. Heavy bovine casualties and a damage suit resulted. After this an overhead bridge was built and across this the cows were driven to and from pasture. This was used until the dairy project was abandoned. Thus ended the sudden demise of cows which had annoyed the railroad company.—B. W. S., Richmond, Va.

Did Carbon Monoxide Kill Captain Page?

May I call your attention to an article in Popular Science Monthly in which George Lee Dowd, Jr., states that Captain Arthur Page was killed by centrifugal force? I saw Captain Page killed and can assure you that he died from carbon monoxide poisoning. The evening before the race I saw him make his test flight and then the fumes made him sick. In the race his motor froze and quit about a mile before he reached the home pylon. He was carried on for about three miles, after which he turned and tried to climb in and land. His plane fell off before he could land and crashed. A blood test showed the presence of carbon monoxide. Speed" Holman, the winner, was also made sick by carbon-monoxide fumes.—W. J. S., Detroit, Mich.

Carpentry Has No Appeal for Him

I like your magazine quite well, but I think you devote too much space to what so many of these syndicate magazines are doing, telling how to make things, instead of reviewing the great happenings in this rapidly changing world. Personally I would prefer the articles on any of the *sciences* or modern inventions and not so much carpentry.—W. H. B., Boston, Mass.

Arizona Wants You, J. S. of St. Louis

I would like to meet J. S. of St. Louis personally and tell him what I think of his opinion of automobiles. He ought to be ashamed, in this modern day and age, to make the statement he did in "Our Readers Say." He should have lived two hundred years ago. But perhaps the sound of the horses' hoofs would have annoyed him. I believe he is just a narrow-minded super-pessimist. If he wished to make a cross-country trip, perhaps he would prefer a good, dependable mule to the modern comfortable automobile.—W. W., Clarkdale, Ariz.

A Well-aimed Knock for Michel Mok

Your contributor, Michel Mok, has tried hard to convince himself that machines do not deprive men of jobs and he may believe he has convinced others. But he himself still believes that machines do deprive men of jobs. Funny, isn't it? If he didn't he would not mention "cures" for unemployment at the windup of his article. Mok believes absolutely that there is not work enough to go around. He cannot realize that though elevators burst with grain, that does not prevent a farmer from raising more of it. He cannot see that if stores and warehouses are full of unsold clothing a tailor can still make himself a wardrobe full of clothes. Mr. Mok has learned so much that is not so that he, I am sure, would spurn to learn more even though it were true. But why should you give first place to these nonsensical speculations of a man who does not believe his own gospel?—H. W. N., Pittsburgh, Pa.

Locomotive Models Are in Demand

I agree with C. F. S., Jr. The models he chose were good, but I would suggest a half-inch scale model of the B. & O. "President Washington" locomotive. Or a three-eighths-inch scale model of the "Ford Pacific" locomotive. The President Washington locomotive runs on a two-and-one-half-inch gage track. The Ford Pacific locomotive runs on a one-and-three-fourths-inch gage track. Both of these locomotives can be run with either coal or oil. There are several firms that can supply the castings and parts to build the locomotives mentioned above.—E. L. M., Chicago, Ill.

Almost Too Lazy to Talk

Couldn't you give us a little article on magnetism? And something on electricity? I am very much interested in them and I think many other people would also be interested. Don't you think the human race is getting altogether too lazy? Just imagine for a moment having a stand to hold the telephone receiver! Pretty soon, they'll have to get someone to do their talking for them. Maybe that would be a good thing. What say?—N. C., Wheaton, Ill.

Where in the World Is the Earth Going?

Although I don't want to dictate, I feel strongly that last month's subject for Five Minutes at Astronomy should have been Jupiter. The king of planets is in an excellent position for observation. Astronomy is one of the important subjects in the scientific world, and I think it only fair to give it at least one one-hundred-fifty-second of the space in your magazine. It might also be well to add that the sun is traveling toward Vega and carrying along with it nine known planets among them the earth. But no one seems to know just where the sun is dragging the earth.—M. H. S., Ossining, N. Y.

Bans the Idea of Making Changes

You have printed on "Our Readers Say" pages many letters telling you what to print and what not to print, but I believe that if you cut out anything your magazine will lose its attraction for many readers. While I prefer articles on aviation I like the magazine as it is. The letter sent in by "C. C. & R. G.", Cincinnati, Ohio, complains about the space given to aviation. This is an industry of immense importance and destined to become much more so when it has been given the backing that railroads and automobiles have.—D. W., Mott, N. D.

Reader from Fossil Proves He's Not One

I don't assume that we are all aviation fans by any means. There always will be, for some time at least, a certain element of "old fogies" and mid-Victorians who bitterly resent the spirit of progress. Aviation is destined to become the most important and useful of all forms of transportation and is recognized by many of the most prominent figures in the world today as an industry that may soon rival the automobile and motion picture industries. For some time Henry Ford has manufactured airplanes. Not long ago General Motors purchased controlling interests in the Fokker Aircraft Corporation. These big business concerns aren't throwing any coin at the birds or making kites out of banknotes. They see a future in aviation. The Federal Government has made big appropriations for the construction of aircraft for the Army and Navy in 1931. Aviation is here to stay and the more you print about it the better it suits me and I venture to say there are hundreds of other readers like me. Aviation needs publicity and I commend you very highly on the attitude you are taking. Aside from that, aviation *is* a popular science, if you ask me.—R. S., Fossil, Ore.

Maybe Your Sand Hills Need This Food

I have read a number of articles on the forced chemical feeding of plants, the last being your article "Homemade Plant Pills Grow Crops in Sand Hills." I have a formula that originated, I think, with the U. S. Department of Agriculture, and it consists of the following: Nitrate of soda, two parts; phosphate of calcium, one part; sulphate of potash, three-fourths of one part. In each case by weight. A level teaspoonful is dissolved in five quarts of water and applied to the plants every two or three weeks. This is for potted plants. In the garden it could be used in a more concentrated form. Nitrogen three parts, phosphorus eight parts and potash, eight parts, will increase sweet potato yield.—A. L. W., Sykesville, Md.

This Little Girl Has a Big Problem

I am just an inquisitive girl with a problem I want someone to work out: If two airplanes start at sunrise on June 21, 1931, from the same point, one going west and one going east and each flying at the same speed of 100 miles an hour, how long would each one's day be? I have wondered and wondered about this and have been unable to find a solution. I hope the readers of your wonderful magazine will be more successful. Incidents, I advise you to pay no attention whatever to the criticisms of Popular Science Monthly. The writers just like to pass the time away.—R. E. H., Elyria, Ohio.

POPULAR SCIENCE MONTHLY

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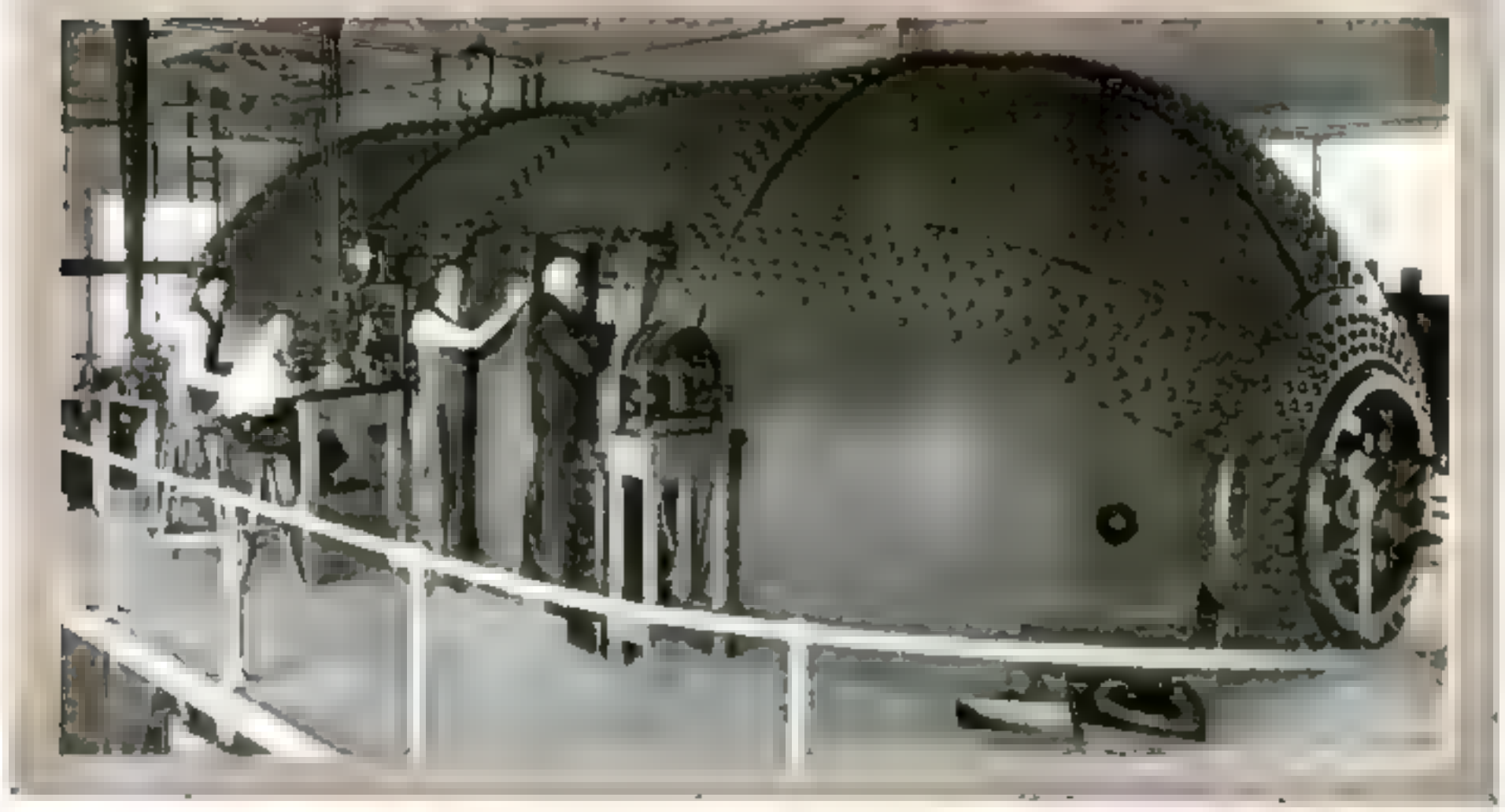
SIXTIETH YEAR

May, 1931 • RAYMOND J. BROWN — *Editor* • Vol. 118 No. 5

Giant Laboratory *Reveals Secrets* of Foolproof Flight



In this variable density wind tunnel the air is compressed to suit the size of the model plane under test

By MARSHALL ANDREWS

NOT long ago a group of aeronautical engineers stood at the Anacostia Naval Air Station, near Washington, D. C., and watched a newly designed Navy bomber howl down from the skies in a 6,000-foot vertical dive. Attached to the plane was a 1,000-pound bomb. In the cockpit was William H. McAvoy, test pilot for the National Advisory Committee for Aeronautics.

When the plane reached the end of its long dive, it was traveling four miles a minute. Pulling out into horizontal flight imposed on pilot and plane a sudden change in direction of inertia that caused each to weigh eight times as much as normally.

Immediately after his unprecedented dive, McAvoy put his heavy bomber still carrying its half-ton bomb, through a series of maneuvers usually restricted to pursuit planes and unheard of before in planes of such size, weight, and load carrying capacity.

That the plane was able to come through its experience unscathed was the result of experiments conducted by the National Advisory Committee at its Langley Memorial Laboratory at Langley Field, Va.

Until the committee had conducted its many tests in laboratory, shop, and hangar, as well as on the flying field, it was not known to what extent the tail surfaces of an airplane are affected in power dives. In fact, an official of an airplane company that recently lost an experimental type of plane when it went to pieces in the air during a power dive said that four days later he received a report from the National Advisory Committee for Aeronautics detailing results of its tests with tail surfaces that would have saved the plane had it arrived during construction.

THE N. A. C. A. has contributed much to aeronautics, but few persons outside of the aviation industry realize to what extent it has affected safety, speed,

and efficiency of flight, all of which con cern the man in the street

When you step into a modern commer cial airplane you will very likely find th engines covered with the cowling, dev oped by the committee, that enabled Cap Frank Hawks to get an extra twenty mil an hour out of his fast monoplane; it also on Colonel Lindbergh's Sirius

The wings will likely be fitted wit elliptical tips, a design which the commit tee determined in its wind tunnels to be the most efficient type. It may even b powered with high speed Diesel engine which were made possible by res work in the committee's laboratories

IF a few years commercial p are flying at altitudes up to eight mil taking advantage of every vagary of wind currents, you may be sure that an engi supercharger, developed by the co tee, and used by Lieut Apollo Soucek making his present altitude records, is forcing air into the carburetor at sea-level pressures

Possibly the airplanes in which you fly in a few years will be equipped with specially built engines, economical in operation and made possible by the committee's development of superchargers for use at sea level

Learning that the committee since its organization in 1915 at the suggestion of President Woodrow Wilson, has made available to the aeronautical industry more than 300 technical reports and over 350 technical notes, almost 600 technical memoranda and some 125 aircraft circulars describing foreign airplanes, I determined to learn at first hand as much as I could of its work

With this in mind, I obtained permission from Dr George W Lewis, director of aeronautic research, to visit the committee's laboratories at Langley Field and flew down in an Army Air Corps plane with Lieut. Louis M. Merrick, operations officer at Bolling Field.

At the Langley Memorial Laboratory I found a group of earnest scientists attacking problems of flight in workshop wind tunnel, and hangar and two quiet pilots who try out in the air whatever solutions the engineers have reached in their experiments. Both pilots, McAvoy and Melvin M. Gough, are engineers.

THERE I saw the largest wind tunnel in the world, just nearing completion, in which a full sized plane may be placed for tests. I saw the world's largest seaplane channel, more than 2,000 feet long twelve feet deep, and twenty-four feet wide in which any seaplane hull may be tested at speeds attained in taking off under actual service conditions

I was shown the largest high pressure wind tunnel in existence used for testing propeller and other airfoil sections at speeds up to 1,200 feet per second or 900 miles an hour

There was the "rubber engine," developed by the committee for test purposes. This is a single-cylinder internal combustion engine that may be used either with a carburetor and the usual fuels or with any grade of heavy o[il] ... Diesel type ... further it may ... used with carbur[etor] ...

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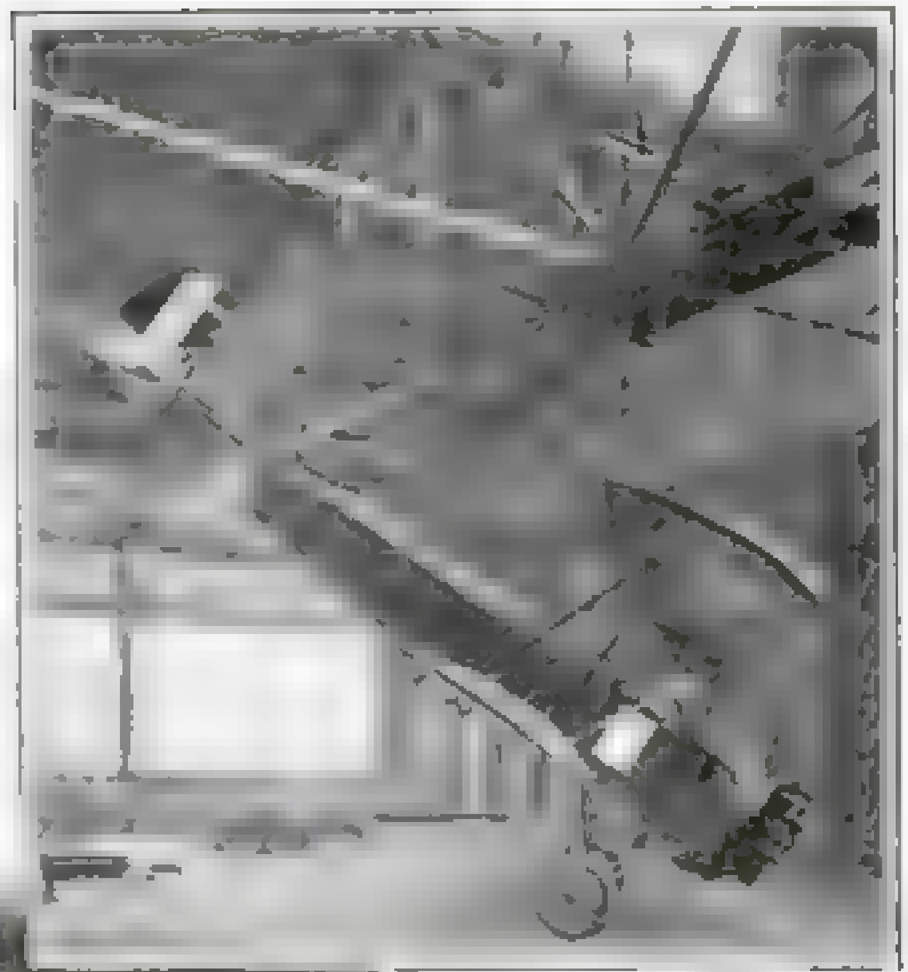

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How smoke is used to determine the course of wind currents through an airplane engine cowling while the engine is running at high speed.

development of the present Diesel type aircraft engine and, in fact, made that engine possible, must take 4,000 pictures per second in order to catch the spray action from the moment the fuel is injected until it penetrates the chamber and is ignited

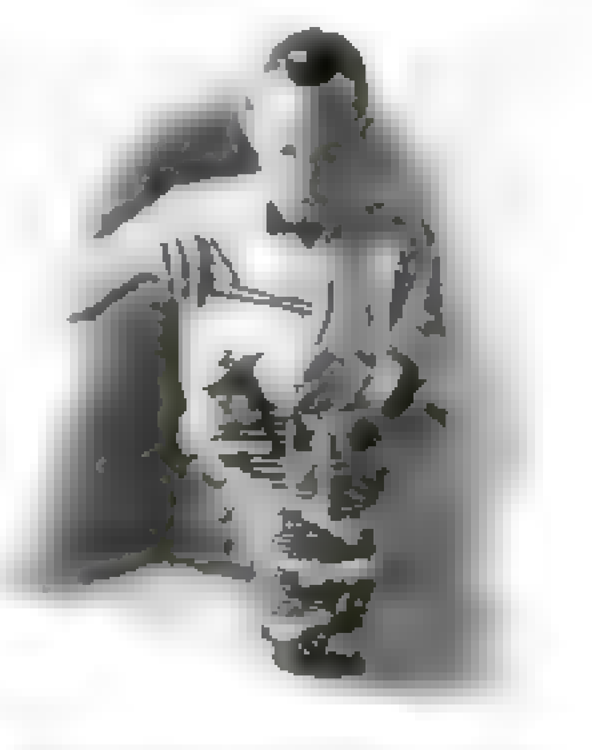
In actual use it makes twenty-five pictures on one film in three thousandths of a second, the complete series showing exactly what occurs when any type of oil is injected into a cylinder under any predetermined pressure through any type of jet.

THE jet is inclosed in a chamber with glass walls one inch thick to withstand the tremendous pressures imposed upon them. Light for making the pictures is obtained by means of a jump spark across a one-inch air gap, the necessary current of 30,000 volts being built up in a group of condensers designed by N. A. C. A. engineers. The light beam is deflected so as to illuminate the chamber but not interfere with the camera lens. Twenty-five sparks are sent across the gap each time a series of pictures is made, yet so rapidly does the operation take place that the observer hears and sees only one sharp crack

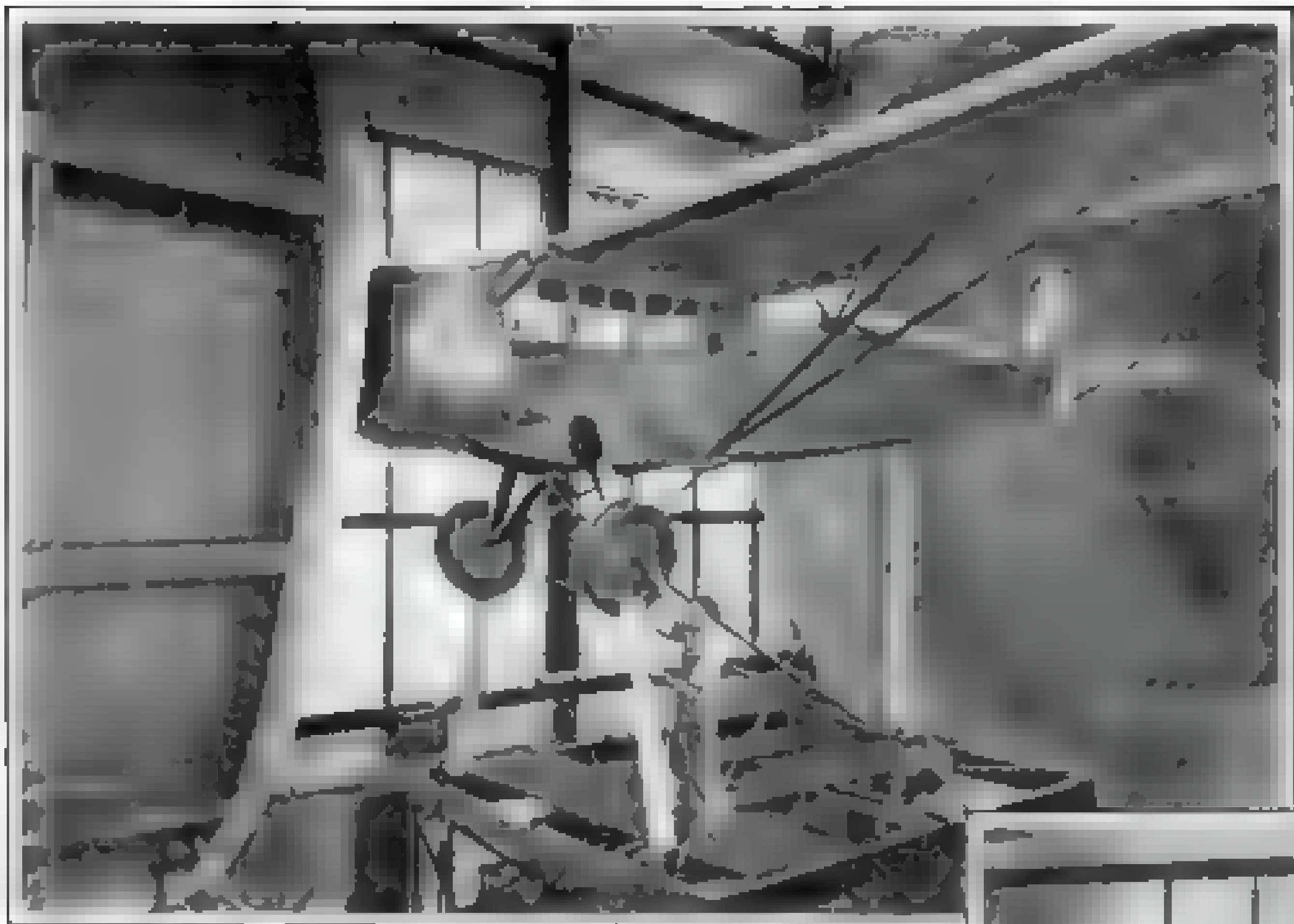
Photography is used extensively by the engineers of the committee. In all of their flight tests instrument readings are photographically recorded so that nothing is left to guesswork. Pilots may argue about their reactions under peculiar conditions of flight but the camera preserves the actual story for scientists to study

The instruments used by the committee's engineers would be interesting enough under any condition. But when it is considered that every recording instrument the committee uses has been designed for the purpose because none was available elsewhere, these remarkable instruments take on added interest. They can be seen in no other laboratory

In one case, when the seaplane channel



Thermocouples placed on an engine prior to tests show effect of heat while in operation.



Th[illegible] N A C A [illegible] research [illegible]

was [illegible] to remove from the are a number of unexploded aerial [illegible] bombing [illegible] Second [illegible] able in fact [illegible] trying [illegible]

THE problem was [illegible] N. A. C. A. engineer[illegible] instrument carrying a group of induction coils that would set a buzzer in [illegible] when it was carried over a buried piece of metal. An operator wearing earphones walked alongside and determined the presence of unexploded bombs. Using this instrument, many bombs were unearthed and destroyed that might have caused serious trouble had a steam shovel or workman's pick struck them.

One instrument used in flight tests is called an "automatic observer." It consists of a box containing at one end a group of conventional aircraft indicators, such as an altimeter, a tachometer, an oil pressure indicator, an oil heat indicator, air speed meter, and others. At the other end is a camera that photographs these instruments while the plane is in flight, making a permanent and accurate record for future study.

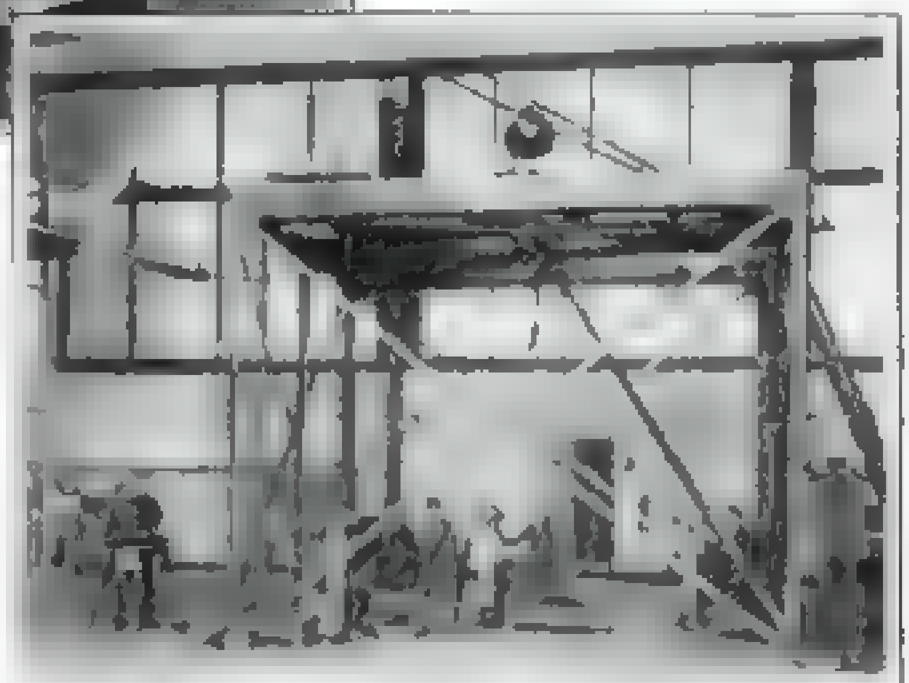
Another instrument designed by the committee is connected with the controls of the plane used in tests and makes a photographic record of each movement the pilot makes to change the attitude of his plane in various maneuvers. Another indicates and photographically records inertia forces set up in an airplane when it is violently maneuvered in flight.

These and other instruments developed by the committee may be connected with still another which synchronizes them so that their recordings are definitely

[illegible] accident.

When I was at Langley Field [illegible] plane for spin testing in connection with the safety research now under way. Carrying 300 pounds of lead shot in the tail and another 300 pounds near the nose so as to change the center of gravity from that originally designed in the plane, he spun down from 8,000 feet to 3,000 feet.

On the ground we argued about the attitudes the plane took while spinning. Some of us thought it flattened out, others were sure it changed its path of rotation. The pilot himself had other ideas when he landed. But from the time he started his long spin until the plane was brought back into normal flight the instruments he carried were making a photog[illegible] happened.



The engineers in this room are studying the instruments upon which appear the results of the cowling tests shown at left top

ONE of the most interesting instruments designed by the committee contains sixty pressure cells, each of which is connected with a tiny orifice in one of the wings or control surfaces so that an accurate determination of pressures imposed in flight may be obtained.

Small metal tubes with rubber connections where flexibility is needed lead from the orifices to the pressure cells in the instrument. These tubes contain air through which pressures reached at the openings must be transmitted to the cells.

Since each instrument is designed for a special purpose, each is different from the others up to one point. That is where the photographic recording is done. This photographic method, developed under stress of necessity by the committee, is simple but extremely effective.

Chief test pilot William H. McAvoy, who made record dives at Anacostia Naval Air Station with a Navy bomber.

IN EACH case, the reactions of the instrument are transmitted through a diaphragm or dashpot to a stylus which actuates a tiny mirror. This mirror is so placed that it reflects a beam of light from a small electric globe through a slot to the film.

As the instrument receives its impression of each change in the plane's attitude, the stylus moves the mirror, causing the path of light to move along the film, making a graphic record. A beam of light makes a perfect medium for transmitting the record, because

A[illegible]plane model [illegible] in this vertical wind tunnel [illegible]

[illegible] has no inertia and is not affected by the speed or violent maneuvers of the plane.

These flight tests have placed N. A. C. A. test pilots in many exciting [illegible]tions, but not one has been injured as a result of a crash. Major Luke Christopher, now secretary of the contest committee of the National Aeronautic Association, while he was N. A. C. A. test pilot attained the highest acceleration ever recorded after a dive at terrific speed in a pursuit plane. When he pulled out of the dive, his plane turned upside down and slid tail first until its momentum was reduced!

Captain Thomas H. Carroll, another former test pilot, went up one day to learn the effect of heavy loads on airplane wing tips. He carried a box of sand on each wing, the boxes being so arranged that he could dump the sand from the cockpit by tripping their bottoms with lengths of string. He tripped one without difficulty but the string on the other broke. He managed somehow to land with 300 pounds of sand pulling down one wing.

Not only are flight tests made and recorded, but these findings are checked or preceded by inside laboratory work. The Langley Memorial Laboratory is equipped with seven wind tunnels, each designed for a special purpose, one being a recently completed vertical tunnel for spin-testing models. Another is a variable density tunnel in which the air is compressed before tests are made.

Still another new tunnel permits the model being tested to be mounted without wires, saving much time and labor and placing little resistance in the wind stream. In this tunnel, eighteen models were tested in one day, each model being placed in seven attitudes of flight, making a total of 126 separate tests.

Still another tunnel, known among N. A. C. A. engineers as the propeller [illegible] experimenting with the cowl[illegible] that has aided Captain Hawks in making his many records a[illegible] which Colonel Li[illegible]gh use[illegible]. This same cowl[illegible]

[illegible]

It is in this manner that an airplane model is mounted and whirled for testing in the vertical wind tunnel, exterior of which is seen above

The new full size tunnel, which, it is announced, will shortly be ready for its first tests, is a marvel of construction and design. When one enters it sees the two 4,000-horsepower electric motors that will drive the thirty-four-foot four-bladed propellers, and stands in the sixty foot throat through which air will be passed at 100 miles an hour, the immensity of the tunnel is awe inspiring. An idea of its size may be gained from the fact that although the propeller blades are made of [illegible] aluminum alloy, each weighs 1,100 pounds.

Notice the icicles clinging to this propeller. This is one test to determine effect of icy air.

In the variable density tunnel, resembling nothing so much as a big ellip[illegible]r air is compressed before forc[illegible] over models so as to approximat[illegible] [illegible]ct as possible actual flight condi[illegible] As Doctor Lewis explained it, a [illegible] built on a scale of one to twenty [illegible]aced in the tunnel and the air compressed so that each molecule is one twentieth normal size. Thus compressed [illegible]r passing over a small scale model gives the result of a full sized plane flying in normal air.

But the air that has been compressed for use in the big boilerlike tunnel is not wasted after it has been used. From the tunnel it is passed into a smaller vertical tunnel [illegible] by which is designed as a venturi tube, intaking air from the room in which both are located and exhausting it out doors. Use of this tunnel enables the committee's engineers to obtain air speeds as high as 400 miles an hour for testing propeller designs and other airfoils which must stand up under excessive speeds.

In the engine laboratory, the same unending research for safety, reliability, and efficiency is being carried out. Recognizing the great danger from fire which always dies with the modern airplane, the N. A. C. A. is now conducting experiments looking toward reduction of heat from exhaust gases.

For instance, the use of exhaust collector rings on radial air-cooled engines promises much from the standpoint of efficiency, because they can be used as part of the cowling. But they increase the fire hazard by becoming heated to high temperatures and igniting spilled gasoline in case of a crash.

The committee's experiments with collector rings led to the belief that air admitted from the outside would keep the ring cool enough to warrant its use with complete safety. But the first attempt led to a queer result.

An air "bleed" was made in the ring near one cylinder. Enough air was admitted in this way to complete the ignition in the ring of unburned gases, actually increasing its temperature rather than lowering it. Placing "bleeds" near a complete bank of cylinders solved the problem.

Although its great mass of technical data never reaches the general public, the work of the National Advisory Committee for Aeronautics is of the greatest value to anyone who flies or expects to fly, either as pilot or passenger. Its research is directed always toward accomplishment of the three most desirable factors in flying: safety, speed, and economy.

Extensive tests in wind tunnels and on the flying (Continued on page 143)

Seek Drug to Save Dope Fiends

Harmless drugs are now being sought by chemists to end the destructive effect of narcotics, as suggested by the figure on the left in drawing

Dr. Wilder D. Bancroft, left, of Cornell University, and Dr. G. H. Richter, have discovered that drugs coagulate human nerve cells.

Research Chemists Attack Narcotics to Find Their Habit-Forming Secret and Produce Harmless Substitute to Cure Addicts and End Vicious Trade

By GEORGE LEE DOWD, JR.

WHAT gives dope its habit-forming property? At present no one can answer that question, but chemists in a special laboratory at the University of Virginia are trying to find the answer. They are seeking a "dopeless dope" that may rescue an army of unfortunates from the body and soul destroying habit that ensnares them.

Under the auspices of the National Research Council, at Washington, D. C., these workers are creating synthetic drugs which it is hoped will replace the present dangerous narcotics. Already they have forwarded thirty compounds to a second laboratory at the University of Michigan, for exhaustive tests upon animals.

This cooperative work is but one step in a new attack upon the drug problem in America. As a backbone for this offensive, a nation-wide chain of anti-narcotic committees, working with official backing, was advocated recently by Charles H. Tuttle, former District Attorney at New York City.

One competent authority estimated the number of "drug fiends" in the United States at nearly 2,000,000 (P.S.M., June 30, p.42). Since the advent of Prohibition, dope addiction has increased steadily. In the last ten years, the number of drug users is believed to have quadrupled. In one state alone, California, the cost of dope addiction is placed at $7,000,000 a year. In spite of strict laws against smuggling, an avalanche of illegal drugs continues to engulf the country. Thirteen million dollars worth of narcotics were confiscated by Federal agents during the past year, and this probably represents but a fraction of the amount reaching our shores.

With less than 250 narcotic agents to guard 4,000 miles of border and 20,000 miles of coast, it is impossible to prevent all illegal drugs from entering the country, especially when they come disguised as any one of a thousand innocent, everyday commodities.

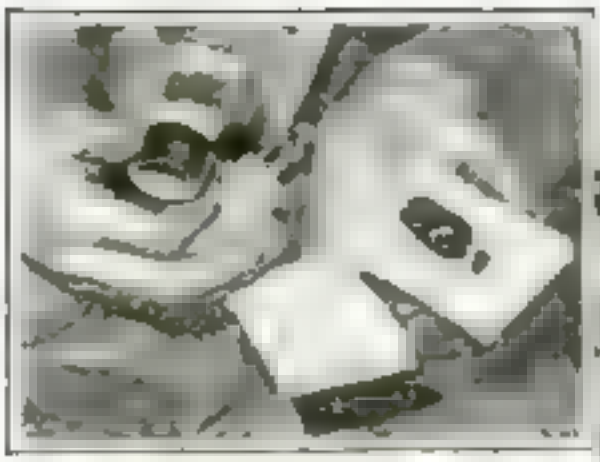
ONLY a few weeks ago, Federal men uncovered one of the latest ruses of a cunning smuggler of dope. A shipment of harmless-appearing yellow paraffin aroused their suspicions. They examined it closely and discovered that the paraffin was impregnated with heroin, a powerful narcotic derived from morphine. All that was necessary to extract the dope was to dissolve the wax, when it precipitated fifty percent heroin.

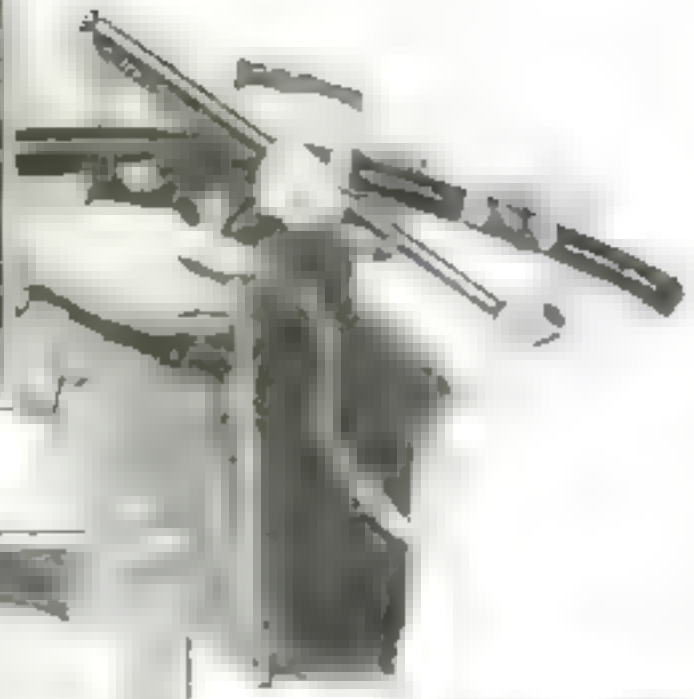
Even more astonishing was another haul on the Pacific coast. A thousand pounds of dried raisins had been shipped from the Orient to the United States. Although the fruit appeared to be perfectly normal, tests showed that the raisins had been soaked in a morphine solution and had absorbed large quantities of the drug.

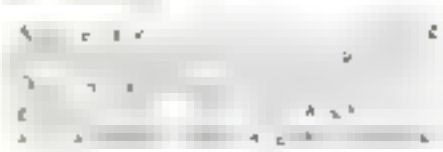
AS MUCH as ten percent of the raisins was morphine which could have been extracted easily by the dope peddler for whom they were intended. In another case, a shipment of dried figs was found to be similarly treated, having been soaked in a solution of heroin.

Often the narcotic is secreted in a shipment of legitimate merchandise to be removed somewhere in the United States while the boxes or bales are in transit. One plan of this sort, which miscarried, came to light not long ago when officials of the Bigelow-Hartford Company, manufacturers of carpets at Thompsonville, Conn., discovered nearly forty pounds of opium hidden in a bale of Turkish wool imported from Constantinople.

Turkey is the seat of most of the narcotic factories of the world. The opium in the bale was contained in six canvas belts, each having ten pockets. In them the opium was packed in slabs wrapped in red paper on the outside, tinfoil on the inside, and tied with a gold string. The







This clever ruse was discovered in Hawaii. The opium, shown above, was hidden in the doorlock.

contraband drug was discovered when the bale was opened preparatory to placing the wool in the picking machine, and was turned

MORE than a thousand pounds of opium was captured a few weeks ago in a raid upon a warehouse in New York City. Three large wooden packing cases, designed to look like ordinary merchandise contained the bricks of opium put up in fifty hermetically-sealed metal containers.

The latest racket among opium smugglers was uncovered a few days ago in New York City. Members of the narcotic squad captured three Chinese "dope hijackers" just as they prepared to hold up a Polish seaman, known as "king of the dope ring," and rob him of a bag containing thirty-six pounds of crude opium, valued at more than $30,000. The seaman and the Chinese were taken into custody. Hijacking among bootleggers has long been known to the underworld but narcotic hijackers are said to be new to the police.

The ports of New York on the Atlantic and Seattle and San Francisco on the Pacific are the chief points of entry for smuggled drugs. In Seattle, recently more than a thousand cans of opium was discovered hidden under 120 fathoms of anchor chain in the hold of the steamship *Inaba*, arriving from the Orient. During another raid, narcotic agents found fifty cans of opium concealed in the carcasses of three frozen sheep stored in the provision refrigerator of the steamer *Stuart Dollar*, of the American Mail Line.

A FEW months ago, Federal officers received a tip that smuggled opium was coming in on the steamer *Shinyo Maru*, arriving in San Francisco from Yokohama. When the vessel entered the Golden Gate, an extensive search was made. Finally, a spot on the ceiling of the dining room used by third class passengers attracted their attention. It was freshly coated with white paint. When the place was broken open, the officers found a large bundle of opium hidden in the compartment between hold No. 4 and the pantry.

IN THIS, as in many cases, the slippery smuggler escaped, although his contraband drug was confiscated. After the narcotics enter the country, they are carried by drug peddlers in a thousand and one ingenious hiding places.

A large vault in the basement of the Government building in Washington where the Narcotic Bureau is located is filled with a weird collection of cunning devices for transporting dope. Books with hollow backs, shoes with dope-filled heels, canes with hidden compartments, fountain pens packed with morphine, cameras and carpet sweepers loaded with illegal narcotics are but a few of the exhibits in this huge collection.

They were all used to conceal one of four drugs—opium, morphine heroin, or cocaine—the narcotics used by addicts. The first three are products of the opium poppy, grown in China, India Egypt, and Turkey. The last, cocaine, comes from the coca leaf of Peru and Java. It is interesting to note that the Java leaves yield twice as much cocaine as those from South America.

UP TO the present, the main effort in fighting these four drugs has been along the lines of preventing their sale and illegal entry into the country. The Virginia experiment represents a relatively new departure in treating the dope problem. If safe substitutes can be found there will be no legitimate excuse for manufacturing present narcotics. Then, say Government officials, "Instead of hunting the pellets, we can prevent the pulling of the trigger; instead of mopping up the water we can turn off the faucet."

In this hope, the scientists have at least one victory to encourage them. About a quarter of a century ago, novocaine, a relatively harmless narcotic was produced from cocaine. The chemists who discovered it began by a study of the molecules of cocaine, which is a vegetable derivative.

They carried on their researches until they learned the arrangement of the atoms in the cocaine molecule. One part of the molecule, they discovered, produces the beneficent effect of cocaine. Another part is related to nicotine, the poison found in tobacco, and a third part to the deadly alkaloid contained in hemlock, the poison the Greek philosopher Socrates was condemned to drink.

By eliminating the more dangerous parts of the molecule, they produced novocaine, called during the World War one of the three most valuable and indispensable drugs. The fact that it is not habit-forming is recognized. Several times, dope peddlers who were able to prove they were selling novocaine to people who thought they were buying cocaine had to be freed after they were arrested, as no law forbids the sale of novocaine.

However, in at least one important respect this new (Continued on page 134)

Soviet Slaves Rebuild Red Russia

By MICHEL MOK

INTO the next ten years the Russian people must pack the work of a century, or the Soviet's big plan to turn Russia into an up-to-date industrial nation will fail. These, in substance, were the words, a few weeks ago, of Joseph Stalin, dictator of Russia. At his utterance 160,000,000 Russians pricked up their ears in surprise. It was the first time the great mass of the Russian people had heard anything at all about a "ten-year plan."

Since 1928 they have been hearing a lot about the so-called Five-Year Plan. In and out of season, the Soviet government pounded into their minds the idea that by 1933 Russia must be a thriving industrial nation, a world power. As though by magic, this vast, backward farming country was to be changed, in five years, into one gigantic efficiently run factory. This miracle was to be accomplished by doubling Russia's production of steel, oil, and coal, tripling its output of metal, and quadrupling its manufacture of machinery.

In a manner of speaking, the Russians had the Five-Year Plan for breakfast, lunch, and supper. Public speakers, newspapers, magazines, and books told them over and over that the Five-Year Plan *must* succeed. At the theaters they saw plays and movies and heard operas glorifying the Five-Year Plan. At night, they dreamed about it.

By 1933, they were told, Russia and the Russians would be sitting pretty. Everybody would have plenty to eat and to wear. Nobody would have to work more than six hours a day

Women are doing their share of the work in the present struggle to rebuild communist Russia.

There would be good houses and cheap automobiles for all. Then would come the spreading of this workmen's paradise over the rest of the world; in other words, the establishment of a communist dictatorship that would lord it over the Eastern and Western Hemispheres.

IT must not be forgotten, though, that while their "paradise" is in the making the majority of Russians are minus shoes and warm clothing. A returned American engineer tells of a group of disgruntled workmen complaining to the communist boss in charge of the job. "We have no shoes to wear," they told him. "Don't be foolish," was the reply. "Who ever heard of anybody wearing shoes in Paradise?"

Inspired by visions of ease and plenty and fired by their leaders' crusading zeal, the bulk of the Russian people, since 1928 have been working like slaves. They have done without luxuries, without comforts, even without the necessities of life. Their wheat, their meat, their butter, and their eggs were shipped out of the country to buy foreign machinery and to pay foreign experts. They lived virtually on black bread. They grumbled, but they submitted. All this drudgery and hardship would last only a little while. Everything would be all right by the fall of 1933.

Now comes Stalin and tells them that the promised land is not two and a half years, but ten years off. Ten years more of black bread, poor clothes, ceaseless toil, struggle and sacrifice. Ten years more of the rule, "no work—no food." Ten years more of a system by which workmen are shipped to jobs in any part of the country where they are most needed, whether they want to go or not. Besides, there is now serious talk of compelling the women to work in industry. How are the Russians going to take these things?

EVEN before Stalin began to talk about ten years, there were plenty of people in Russia who thought that five years of privation was too much. They tell the story of a man hurrying along the streets of Moscow. A friend stopped him. "What's the great rush, Comrade?" he asked. "I am going to throw myself into the river," was the answer. "What's the use of living? No butter, no meat, no eggs, no milk, no clothes. The government has taken it all." "Wait a minute, Comrade," said the other. "Don't you know that everything will be all right in 1933? There will be plenty to eat and to wear for everybody then." "Let me go, Comrade," was the desperate man's reply. "By 1933, there won't be any more water left to throw myself into. They will have used it all for their power plants."

This girl is a student at Sachkova where she is learning something about machinery. She is at a polishing bench.

STALIN'S statement surprised nobody outside of Russia. As a matter of fact, experts in this country and Europe agree that it will take not ten but twenty-five years to carry out the Soviet's ambitious scheme. Sooner or later, Stalin and his associates will have to come out with the whole truth. They will have to admit that the Five-Year Plan was only a dodge, a pretty bauble dangled before the people's eyes to make them work, and that they had four more "five-year plans" up their sleeves.

Will the Russian people then feel cheated and rise in revolt against the Soviet regime? Or will they be made to see that it was "all for their own good"?

Nobody can answer those questions now. Stalin himself would give anything to know the answer. It is the Soviet's chief source of worry. If the group of one percent of the population that now bosses the rest can continue to impose its will on the other ninety-nine percent, Russia, or rather the U. S. S. R. (Union of Socialist Soviet Republics) may be a world power to reckon with twenty years from now. If it can't, there probably won't be any U. S. S. R., and all its bold plans will fade into thin air.

Meanwhile, the Soviet has been sufficiently successful to give statesmen and economists in other countries something to think about. They know that, if the communists are completely successful, the rest of the world will have to pay the price of that success.

SOME weeks ago, during a session of the Council of the League of Nations at Geneva, Switzerland, delegates from twenty-eight countries met behind closed doors to consider means of averting the dangers that would threaten the rest of Europe and the United States if Russia should become the great red world power the Soviet wants it to be.

Until now, Stalin and the rest of the Soviet leaders have managed to impose their will upon the Russian people. In all parts of that vast country, which includes nearly half of Europe and third of Asia, they are working like beavers to bring about their communist paradise.

TAKE, for example, the iron and steel works at Magnetogorsk, in the remote Asiatic Urals. Last May, there wasn't a soul in the place. Even today you can't find it on any map. But 35,000 men now are toiling there day and night, in three eight-hour shifts, to build Russia's "Gary

Ind.," the world's largest steel center outside the United States

With a scheduled output of 3,000,000 tons of iron and steel a year, it will be a close second to Gary, which turns out about 3,400,000 tons. Eight huge blast furnaces are being constructed so that eventually they can produce 4,000,000 tons. What will happen to the steel business in this country if the Soviet succeeds? That is one of many questions economists are asking themselves.

THE outlook for success is pretty bright. The resources are there. "Magnetogorsk" literally means "magnet mountain." The temporary city of thousands of tents and barracks housing the 45,000 workmen lies at the foot of a mountain three miles long, two miles wide and 1,000 feet high, that contains 275,000,000 tons of sixty-two percent pure magnetic iron ore.

The project is the heart of the whole Five-Year business, and the Soviet is taking no chances. To carry it out it has invested $400,000,000, the largest single item in the Five-Year budget, four times the amount that will be spent on the Dnieper River power plant which I described last month.

As in the case of the Dnieper dam and all other big jobs now under way in Russia, American engineers are in charge. Two thousand experts from the United States are helping the Soviet turn Russia into a modern industrial nation. At Magnetogorsk a score of engineers of the Arthur G. McKee Co., engineering contractors of Cleveland, O., with Max MacMurray in command, are directing the giant undertaking, involving the biggest contract in engineering history.

THE Soviet, then, has the resources, experienced American executives, and man power enough and to spare. Whether in 1934 or 1935, the great blast furnaces will be ready to grind out enough steel to supply Russian industry—and, perhaps, compete with this country besides—will depend on how it handles its man power.

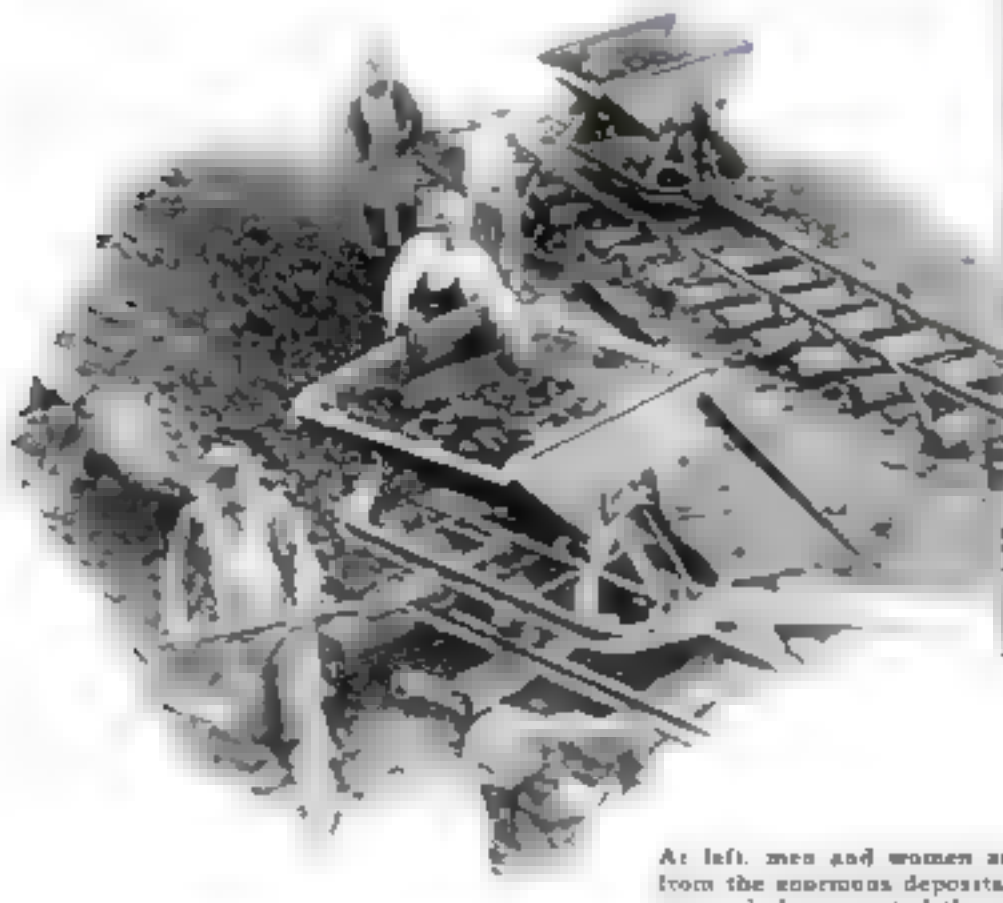
Here, too, the Soviet is not taking any chances. Construction is setting a world record for speed. This is due only in part to the ceaseless communist propaganda. The main reason is that the Soviet, in cases of such big hurry jobs, shelves its socialistic ideas for the time being and remembers that if you scratch a red comrade you find an ordinary fellow who likes to get along in the world. So it uses the much-hated capitalist methods of encouraging and speeding up its workmen—extra pay, bonuses, special privileges, rewards.

FOR instance, 1,500 men at the iron works recently completed a dam across the Ural River. Though it was three quarters of a mile long and contained 52,000 cubic yards of concrete, it was finished in four months. The morning the job was done, each of the 1,500 men received two weeks' extra pay. Fifty of them, who had set personal records, were rewarded with free trips to the "Red Riviera"—Yalta, in the Crimea. Imposing your will on people, if you go about it in that way, may be expensive but it isn't difficult so long as your cash holds out.

Besides, the Soviet on all big construction jobs, has reinstated piece work, denounced by Marx, father of com-

(Continued on page 132)

This giant steel mill is only a small part of the vast equipment that is to turn Magnetogorsk into an active rival with Gary, and have an output of approximately 4,000,000 tons.



At left, men and women are busily engaged in carting ore from the enormous deposits near Magnetogorsk. In this one region it is estimated there are 275,000,000 tons of iron ore.

Pill Box Camera Takes Big Pictures

By ALDEN P. ARMAGNAC

At left, the owl-eyed camera, recently introduced in America, can take snapshots indoors. Below the three foot "Big Bertha" which can be used from a grandstand to take pictures as though the subject was close to the camera.

A NEW YORK inventor is building for himself a camera the size of a small pill box. It will be so small that he can conceal it in the palm of his hand. Yet its diminutive pictures will be easily enlarged to standard snapshot size, or larger, with perfect clearness.

This inventor a photographic "fan," by the way, had grown tired of carrying a bulky instrument with him. Hence the pill box instrument. It will cost him a thousand dollars to build, because the fitting of its delicate parts will be a jeweler's task. Such a camera, the inventor says, could not be produced commercially on this account.

But a camera about the size and shape of a flat cigarette case *could* be built commercially, he says. It would use roll film less than an eighth of an inch wide and carry enough for a thousand pictures at one loading. Such tiny cameras, he believes, are the coming thing for amateur photographers.

The inventor is Dr. Miller Reese Hutchison, formerly Thomas A. Edison's chief engineer whose inventions in many fields have been described before in this magazine. Recently he announced a new discovery that makes possible the microscopic camera.

He has found a way to enlarge photographs to forty-eight times their original dimensions, or more, without losing their clearness, by a process that removes the natural "grain" of the film's surface before enlargement. It is applied while the film is being developed. Any photo finisher might easily perform it. Since the process is inexpensive and adds but five percent to the time of development it may be adopted one of these days by drug stores and other places where amateurs bring their films to be finished.

Dr. Hutchison's new process is just one of the reasons why 1931 is to be a banner year for photographers.

THIS is the year of the new "super-speed" emulsion that realizes photographers' dreams of snapshots at night. It sees the application of the new "photo-flash" lamp to take pictures in places where they have never been taken before. To this country comes the amazing "Candid camera," whose indoor snapshots catch famous people off their guard. In the motion picture world arrives the seeming paradox of "silent talkies."

Anyone who has tried to take snapshots by ordinary electric light will appreciate the tolerant smiles of newspaper photographers at a world's championship boxing match in New York nearly a year ago. They were watching a fellow photographer apparently trying to snap action pictures of the boxers in the lighted arena. But the last laugh was his, for his pictures—first of their kind ever taken—came out perfectly.

THE lucky cameraman was giving the first try-out in actual service to an amazing type of speed plate just perfected by the Eastman Kodak Company. A week later astronomers used the plate to take pictures of the planet Mars and reported that it cut the "time exposure" required to less than half the usual time.

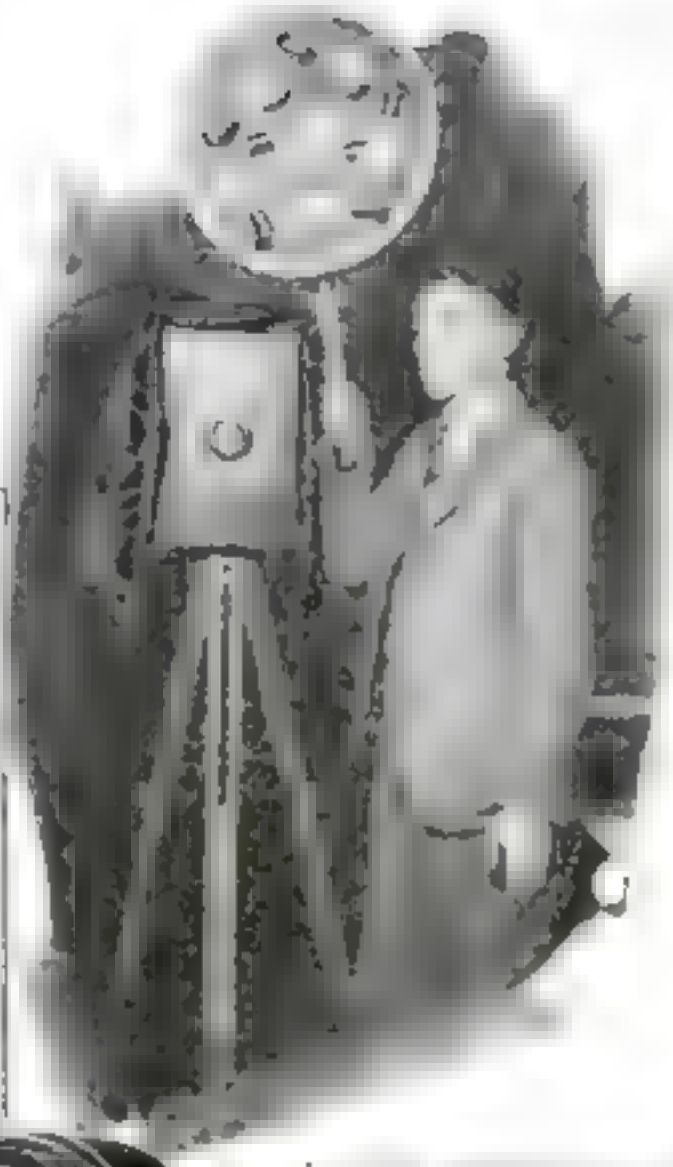
So sensitive are the new plates that a Detroit photographer was able to "freeze" the swift motion of hockey players in action in an indoor arena, using only the general lighting. His shutter clicked open and shut in the short space of one-eightieth of a second to record thrilling moments of one of the fastest of games. At Syracuse, N. Y., a press photographer inaugurated snapshots of street scenes at night without a flashlight, when he snapped a theater entrance and caught people walking past.

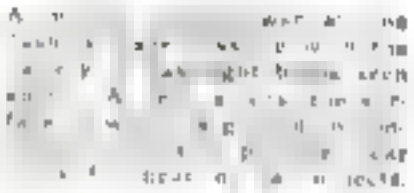
These are things that many a veteran photographer, unless he has kept abreast of the latest news, simply will not believe. But he need take no one's word for it. The new plates are now available at photographic supply stores, in sizes for both amateur and professional, and he can try them and see for himself, if his camera is adapted to use glass plates.

A fit companion for high-speed plates is the Candid camera. Though it nestles unconspicuously in the crook of a photographer's arm, it can take clear indoor snapshots across a room. The enormous lens of this little owl-eyed camera, known technically as an "f 1.8 lens," is as large as the camera itself. It permits good pictures with only a fourth of the light that ordinary speed cameras require.

Instruments That Take 40,000 Pictures a Second and Make a Snapshot with Artificial Light Are Other Photographic Marvels.

Dr. Mercer Reese Hutchinson in hospital [illegible] enlarged from a half inch square of negative seen in upper right of photograph





The Candid camera is not new abroad. About two years ago a German photographer, Eric Saloman, introduced it. A British magazine equipped its photographers with the cameras and printed intimate pictures of well-known people caught unawares, in natural but sometimes ridiculous poses. American senators and other celebrities recently had occasion to keep an eye open for lurking camera men, when the head of a great newspaper chain imported a number of [illegible] tures on the theater stage during the performance without a flashlight, pictures of children, and the best possible photographs in poor daylight. A New York City firm which supplies the cameras on special order recently introduced a model designed especially for detectives.

AMATEUR photographers who yearn to possess such an instrument to try on their friends must be warned, however, that their speedy lens and fast "focal-plane" shutter makes the instruments expensive to manufacture. They cost $200, and press photographers and detectives are the principal users. Their pictures of one and three quarters by two and three eighths inches are microscopically sharp, and can be enlarged to much greater dimensions.

Within the reach of any amateur's purse, however, is an invaluable new aid to conquering darkness and poor light—the new electric flashlight bulb for indoor or night photography. Introduced a few months ago, it is noiseless and smokeless.

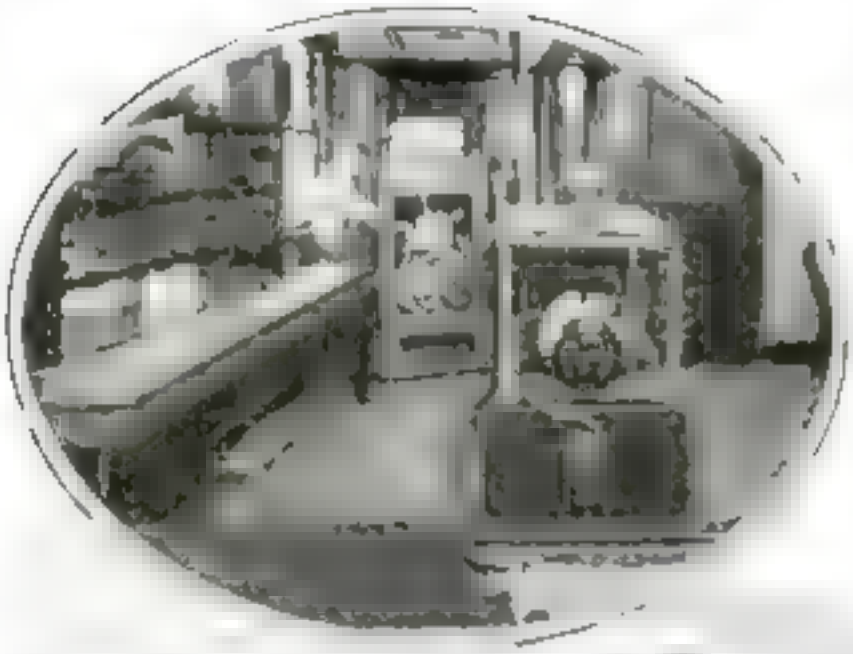
Resembling an ordinary electric light bulb, it contains a crumpled piece of aluminum foil. The bulb is filled with oxygen gas. When it is screwed into any household socket and the switch is turned on, there is an instantaneous flash of light, and a good photograph has been taken, if a camera has been standing ready with

(continued on page 141)

The swift action of an indoor hockey game played at night under artificial light caught in full perfection with a new superspeed plate used by a Detroit photographer.

Spinner Plane Bids for Air Supremacy

Revolutionary changes in aircraft may follow use of new type propeller that adds to speed and is silent.



Drawn by
H
S

POWER TO ROTORS

THREE

A DESIGN for a siren gave Christian A. Volf, Danish-born acoustical engineer, an idea that may lead to such a new departure in aviation as the aerial leviathan on this page.

One day in his New York City laboratory, Volf was struck with the likeness between the spinning rotor that makes a siren's whine and an airplane's whirling propeller. The qualities that make a good siren, he observed, make a bad propeller for one reason alone—noise. Aviation engineers would like to quiet the propellers of airplanes, for they make even more sound than the motor.

Many aviation experts have sought better propellers, but Volf started from an entirely new angle—that of the acoustical expert. A "silent siren" could easily be built. Proceeding on this idea, he set out to design a noiseless airplane propeller. Instead of slashing at air, it would slip through it. The result of his work is a novel "spinner" or rotor rimmed with three-bladed scoops.

Volf set up his new propeller and a standard marine propeller in a tank of goldfish. The fish were struck and killed by the revolving blades of the standard propeller. But they were sucked through the blades of Volf's rotor, following the natural course of the water, uninjured.

Whirling the new rotor in air confirmed that it was silent. But it showed a fact far more interesting. Its tractive force upon models was amazing, according to Volf. The combination of suction and pressure that it produced seemed to give an efficiency far surpassing that of standard propellers.

Out of this idea was born the revolutionary airplane that Volf now proposes. Enormous and silent, it would be driven by eight of the odd spinners, or rotors, that Volf has invented, arranged in pairs. Each pair would have a vane above and below to direct the air through the blades. The whole assembly of rotors and vanes would be revolved at will by the pilot to tilt the ship up or down.

Theoretically, Volf declares, the spinners should be so much more efficient than ordinary propellers that they could support an airplane with practically no wing at all. He proposes first to build a wingless craft, and then add as much wing as turns out to be necessary for flight.

Tony FOKKER

Wizard of Flight

Tony Fokker and the plane with which he won the Ford reliability tour in 1925

Thrills and inspiring determination mark the life story of this great aviation pioneer as it will be told in this and succeeding issues.

Part 1—*Fired from School He Flies to Fame and Wealth*

By
ROBERT E. MARTIN

CHARLES A. LINDBERGH recently told this writer he considers Anthony Fokker the greatest airplane designer of the world. His habitual caution in using superlatives makes such praise even more emphatic.

Reflecting upon it later, it occurred to me that these two, the world's premier flyer and its greatest designer, resemble each other in important respects. Each played a lone hand. Each graduated from the School of Hard Knocks. And each achieved world-wide fame at twenty-five.

Fokker born in the jungles of Java was building a successful monoplane in Europe before he saw his first airplane in the air. Five years later, during the World War Richthofen, Boelcke and the "Flying Circus" of Germany were riding his mechanical hawks to supremacy on the Western Front. His name was almost as well known as that of Lloyd George or the Kaiser. His synchronized machine gun, firing through the propeller, changed aerial tactics overnight.

So valuable was the brain of this twenty-five-year-old genius of the air that at one time Great Britain tried secretly to offer him $10,000,000 if he would leave Germany and build planes for the Allies.

Since the war, his winged air-liners have carried passengers millions of miles in safety. His tri-motored *Josephine Ford* took Admiral Byrd on his daring dash to the North Pole. His *America* carried Byrd and his hardy companions on their pioneer flight over the Atlantic.

His *Southern Cross* spanned the Pacific and blazed a new sky trail around the globe, with Kingsford-Smith and his fellow adventurers. Today, giant Fokker planes, holding more passengers than a standard Pullman, shuttle back and forth over the airways of the west.

FOR nearly twenty years, this name Fokker has been synonomous with the history and the romance of flying.

A coffee plantation, carved by his Dutch father out of the Malay jungle in Java was the birthplace of Anthony H. G. Fokker. Curiously enough, another pioneer of the air, Santos-Dumont, was also born on a coffee plantation—in Brazil. Until Anthony was six, his feet never wore shoes. He ran with the bronze-skinned native children and learned to race to the top of jungle trees with the agility of a monkey.

This happy period ended suddenly. His father decided to retire and returned to Holland. The trip, which then took interminable weeks, is now made in ten days by planes of Fokker design flying over an 8,000-mile airway.

BRINGING young Tony, unused to confinement, to staid Haarlem was like putting a firecracker under a tin can. Sending him to school was applying the match. The excitement began at once. He became the bane of his teachers, the despair of his parents, the Peck's Bad Boy of Haarlem.

One of the few subjects he liked was mathematics. Yet, he never could remember numbers and even today he has to consult a little pocket notebook to tell the dimensions of his latest airplane.

Most of the time in school, his active mind raced with the concoction of new mischief. Half his holidays were spent writing "punish lessons" for his misdeeds. It was on one occasion like this that he produced his first invention, whittling out a piece of wood which would

hold four pens and allow him to write four lines at the same time.

Whenever he could escape from school, he rushed off to his workshop in his father's attic. Becoming interested in miniature trains, he covered the floor with an elaborate system of tracks and switches. He rigged up a wiring arrangement so he could operate all the switches from a chair in one corner of the room, shunting the speeding little trains about the maze of tracks at will.

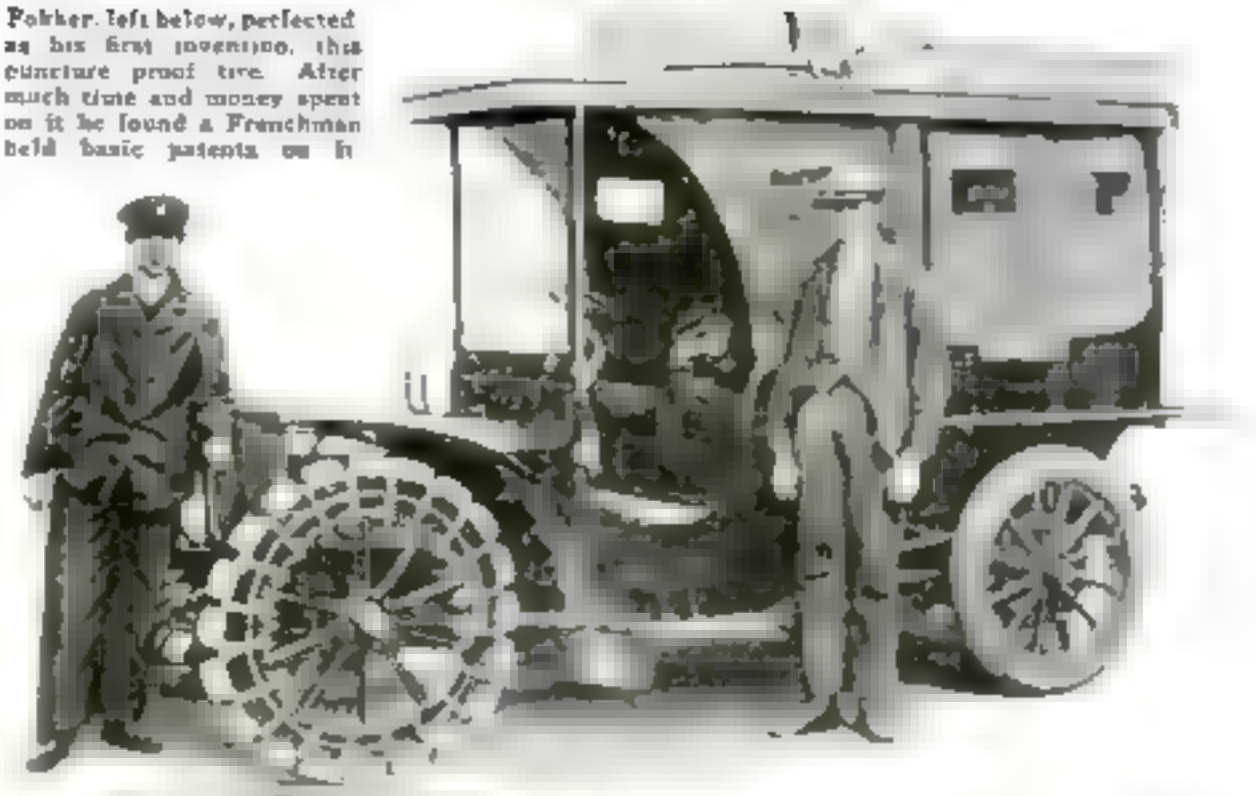
THEN, tiring of winding the springs on the miniature engines, he decided to electrify his road. But the cost of batteries proved too heavy a strain on his purse. After narrowly escaping death in an attempt to obtain electric power from the trolley wire that ran past the house he reversed the order of progress and decided to run his trains by steam.

When his father complained of mounting bills for gas used in generating the power, young Tony tapped a gas pipe leading to a neighbor's house and continued his operations.

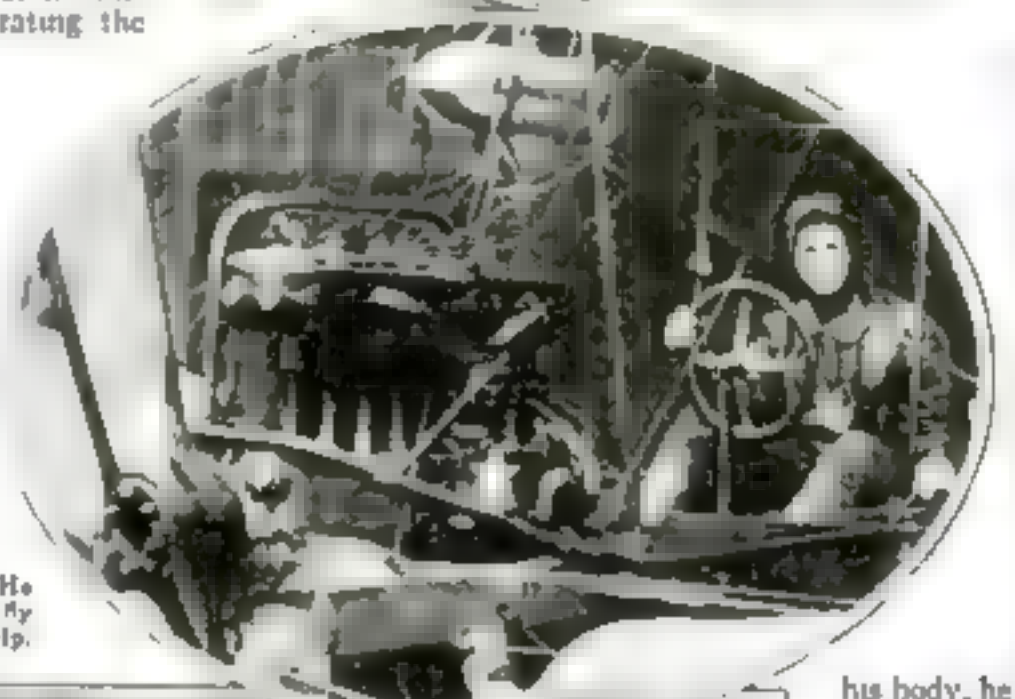
Then he plunged into the building of miniature gasoline engines, turning out tiny cylinder heads that were so small he couldn't make spark-plugs minute enough to fit them.

When he was twelve years old, he asked his father to buy him a canoe. The answer was a pointblank "no."

Fokker, left below, perfected as his first invention, this puncture proof tire. After much time and money spent on it he found a Frenchman held basic patents on it



At right, Fokker's first plane. He designed, built and learned to fly this machine with no outside help.



In this queer looking plane, Fokker made his first flight before the old home town folks at Haarlem, Holland, rising from a tiny field

The next day, when nobody was looking, he sud four long boards in through the attic window, and set to work. The family had grown so used to hearing hammering and sawing above their heads that they paid little attention to the noise issuing from the attic.

WHEN the canoe was built, calked and ready for inspection, Tony invited the family to see it. They opened the attic door gingerly because they had had experience with an electric doorknob he had installed to insure privacy when working in his retreat. When his father saw the completed canoe he was immensely pleased. He sent it downtown to be painted, and the homemade boat was kept in the family for many years afterward.

Although his teachers had long before given him up as hopeless, he managed to pass his examinations. This was due to an elaborate invention upon which he had spent hours of thought. In the top of his desk he had cut a small slit about an inch long and a sixteenth of an inch wide. Around it he carved a tangled pattern to camouflage the hole.

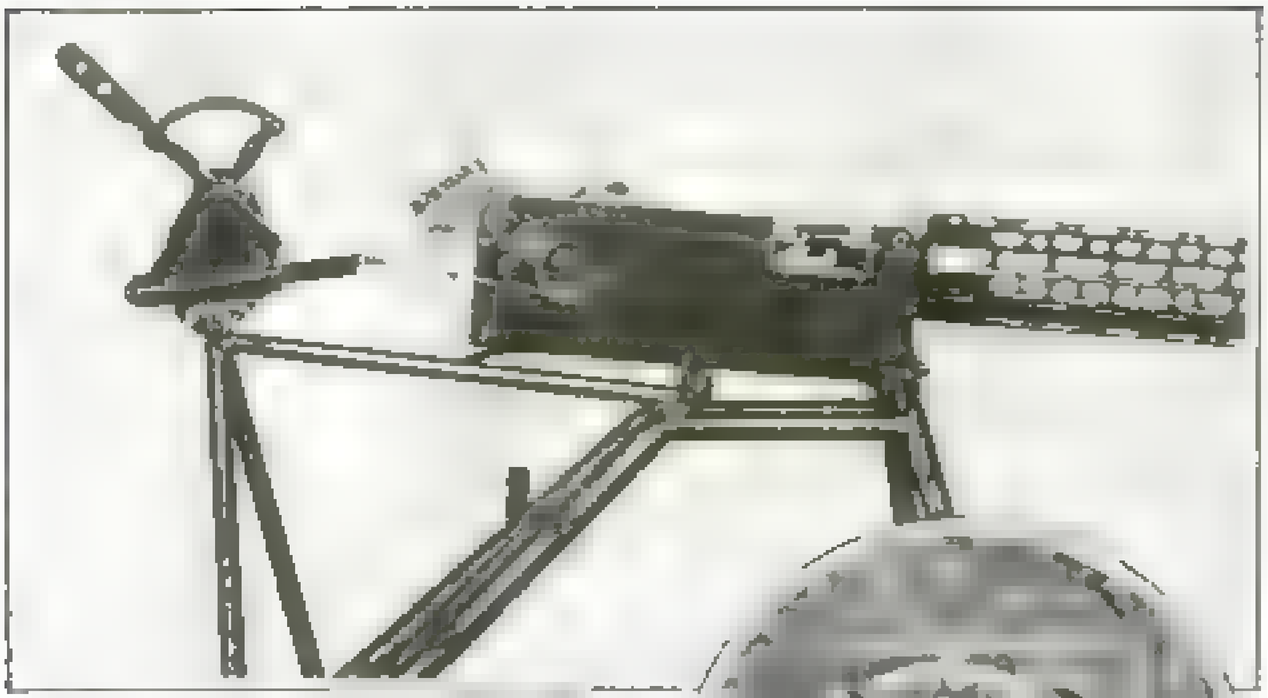
ON THE underside, the slit spread out so an eye held close to the top could take in a wide range of objects in the desk beneath. Here, a revolving cardboard disk contained all the facts and figures that should have been in the young student's head.

By keeping his eye close to the slit during examinations and revolving the disk with slight sidewise movements of his body, he passed with flying colors. He was so proud of his invention that after he left school he showed his teachers how it worked.

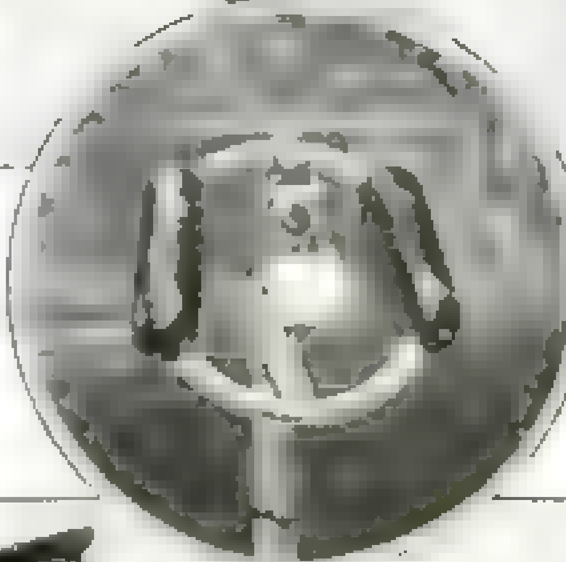
This leavetaking followed his first trip in an automobile. A friend gave him a ride in a 1908 Peugeot "horseless carriage." A few blocks from the start a tire blew out. Later, another went flat. Right then and there, young Fokker decided what the world needed was a puncture-proof tire.

He set to work using springs to replace the pneumatic tube. The first wheel he made fell apart in the middle of the road. A dozen different designs were worked

His first taste of being cheered by the crowds. Herr Fokker, center, is acclaimed by friends after his Haarlem demonstration.



Fokker's machine g...



...strated it to his father ... permission to take a two-week vacation from school to perfect his invention. The vacation extended from week to week and he never returned.

Having no automobile of his own on which to try his wheel he took Fritz Cremer, the boy whose father owned the Peugeot, as partner. Later Cremer became the chief instructor at his flying school during the war and afterwards was his American ...

AFRAID that someone would steal their great idea, the two boys tested their wheel only at night. They gave it endurance tests, chugging along deserted roads with one driving and the other curled up in a nest of rubber tires at the back fast asleep. They tested its speed qualities by a nightly race with the Paris Express, on a straight stretch of road parallel to the tracks between Haarlem and Amsterdam.

After working more than a year on the puncture-eliminating wheel, the design was taken to a patent attorney and Fokker was told a basic patent on the idea had been taken out by a Frenchman twenty years before!

Wilbur Wright cut short young Tony's grief by bringing his biplane to Europe and giving a thirty-one-minute exhibition flight. Immediately, automobiles were forgotten. The young inventor turned to making model planes of wood and paper. His attic became as full of little models as an ancient belfry is full of bats. Out of his experiments with these models he evolved the original ideas of an inherently stable machine which he applied in building his first successful man-carrying monoplane a few years later.

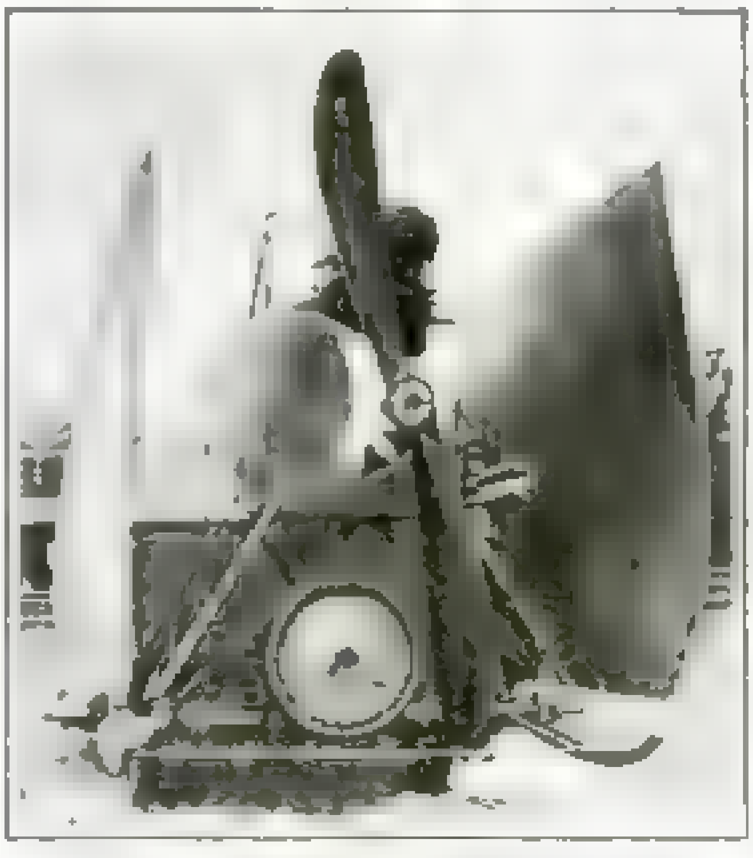
He nailed two levers to an old kitchen chair, to represent the control sticks of the original Wright machine. Working these levers furiously in his attic airport he made a thousand imaginary take-offs and landings. He told his father he wanted to fly. His parent's opinion of aviation was that it was a short road to a broken neck. He would have none of it. And after his son had escaped compulsory military service by pretending to have flat feet, he gave him his choice of going either to a law school ... Delft, Holland, or an automotive ...ing school on the Rhine, in Ger...

The German High Command witnessing a demonstration of Fokker's synchronized machine gun that revolutionized combats between airplanes. This was one of his most remarkable inventions and proved the wisdom of those European countries that vied with each other in making bids for his services.

TEMPESTUOUS young Tony chose the engineering course as the lesser of two evils. But on his arrival he heard of ... school twenty miles away that ... added an aviation course. On ... instant, he packed his bags and switched schools—without saying anything to his father. To his disappoint...t he found the instructors knew little ... what they were teaching, the pilot ... take the student-constructed ... into the air smashed it on the ...; and the class was disbanded.

However, the experience was not a total loss. A wealthy army officer had taken the course, become enthusiastic over flying and offered to pay half the ... of building the monoplane that Fokker had designed.

By hoarding his money, getting back a deposit he had made to cover breakage when he entered the aviation course, and finally by inducing his father to lend him an additional sum, Tony raised sufficient funds to take up the offer and to begin his aerial career.



Fokker's knock-down plane which solved transportation problems and won a valuable German contract.

THE monoplane was assembled in a deserted Zeppelin shed near Baden-Baden where the first passenger flights with a German dirigible had been made.

Just before Christmas, 1910, seven years almost to a day after the Wrights first flew, Fokker's queer monoplane was ready for trial. Its wings swept back and tilted up at the tips, making it inherently stable. No ailerons or wing-warping mechanism was needed to keep the ship on a level keel sideways. In fact, the machine proved too stable. It was not sufficiently maneuverable. Later Fokker planes had ailerons.

The inventor decided to test his invention alone. He rolled the craft with its uptilted wings out onto the deserted field near Mainz, Germany. He cranked the stubborn motor until it barked into action. Then he ducked under the wing and clambered into the seat before the machine had gained momentum. Dripping with sweat, he whizzed into the cold air on a 500-foot hop. As a result, he caught pneumonia and almost died.

Light-headed with fever and excitement over his flight, he tossed about on his bed for weeks. When he recovered he found his monoplane was wrapped around an old apple-tree. His army-officer partner had (Continued on page 123)

ALL MEAT IN CARTONS IN NEW BUTCHER SHOP

Housewives of Evanston, Ill., find a new "butcherless" butcher shop recently opened there a convenience when buying meat. It is one of a group planned to sell exclusively the new "packaged" meat Soft carpets cover its floors, tables and comfortable chairs are arrayed along one wall. Mirrors, modernistic decorations, and softly-shaded lights give it more the air of an exclusive women's wear shop than a meat market

Its wares are all displayed under refrigerated show cases. Each piece of meat is put up in an individual carton at the packing house where all the cutting and trimming is done. They are placed on display with the cartons opened. A transparent covering, however, protects the contents from dust and germs

In this new type butcherless butcher shop all meat is displayed packed in cartons and with soft lights and easy chairs the shop looks like a women's wear store, rather than a meat market

ELECTRIC OUTBOARD MOTOR RUNS CANOE

Canoes and small rowboats are quickly converted to motor boats by a new electric outboard motor which substitutes a quiet hum for the chugging of the conventional outboard. Power is supplied by a six volt battery. The motor, which was developed in Long Beach, Calif., can run for about three hours on one charge at a speed about equal to fast rowing. Reversing is accomplished by turning the motor around on its mounting. Both motor and drive shaft run on ball bearings.

MOHAMMEDANS CALLED TO PRAYER BY RADIO

For many centuries priests have toiled up the steep stairs of tall towers in Mohammedan churches to send their wailing call to prayer floating over cities of the East. Science, however is planning to lighten their labors

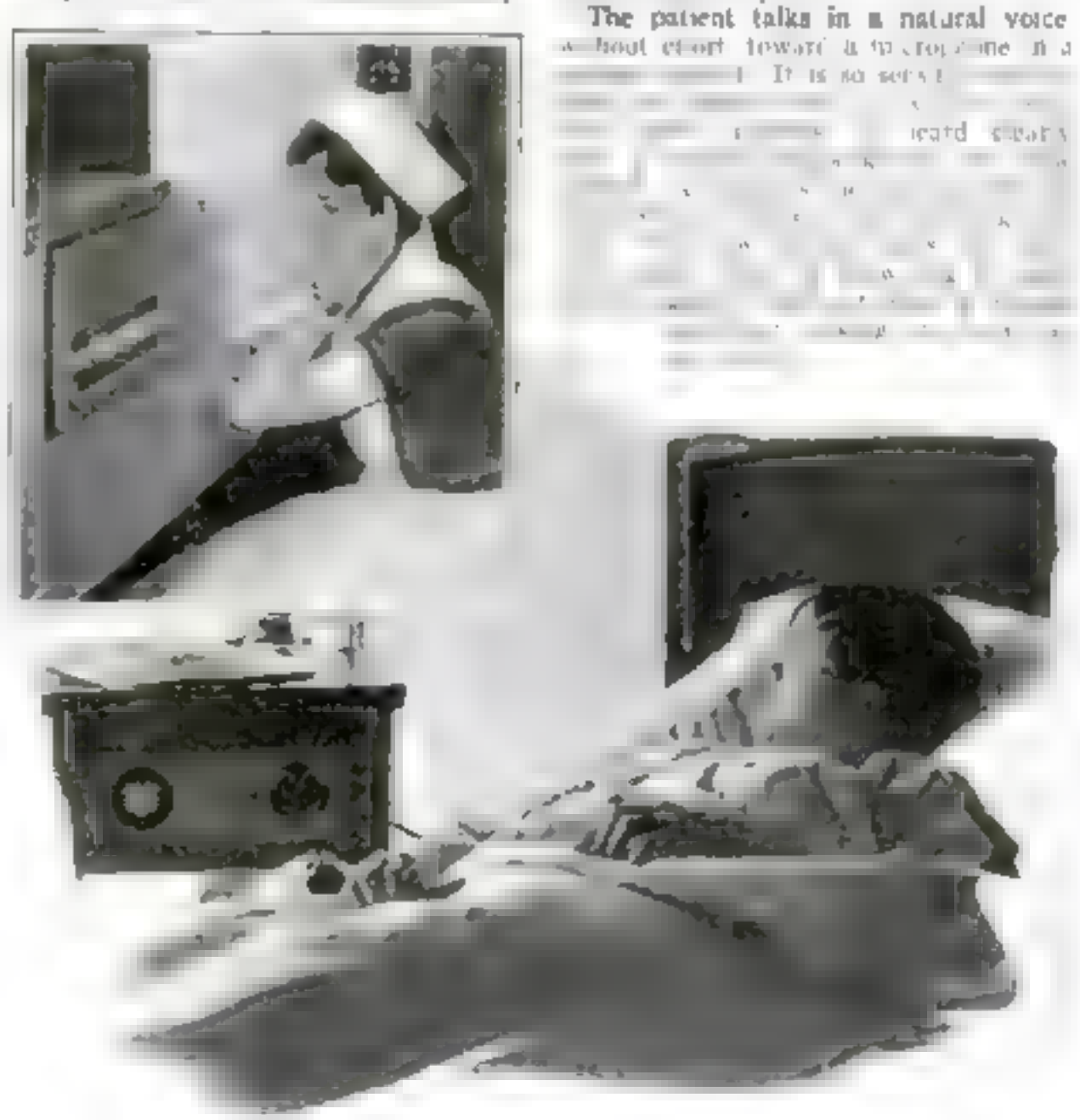
Recent reports that have been received from Turkey say that radio engineers are experimenting with huge loudspeakers mounted at the tops of towers and connected to one central broadcasting station. Thus one priest, or "muezzin," will find his voice multiplied until it carries all over the city, easily reaching all the faithful at one time

NEW HOSPITAL PHONE CALLS NURSE

Now a hospital patient can talk to the nurse at any time, whether she is in the room or not. An ingenious microphone-and-loudspeaker system makes this possible

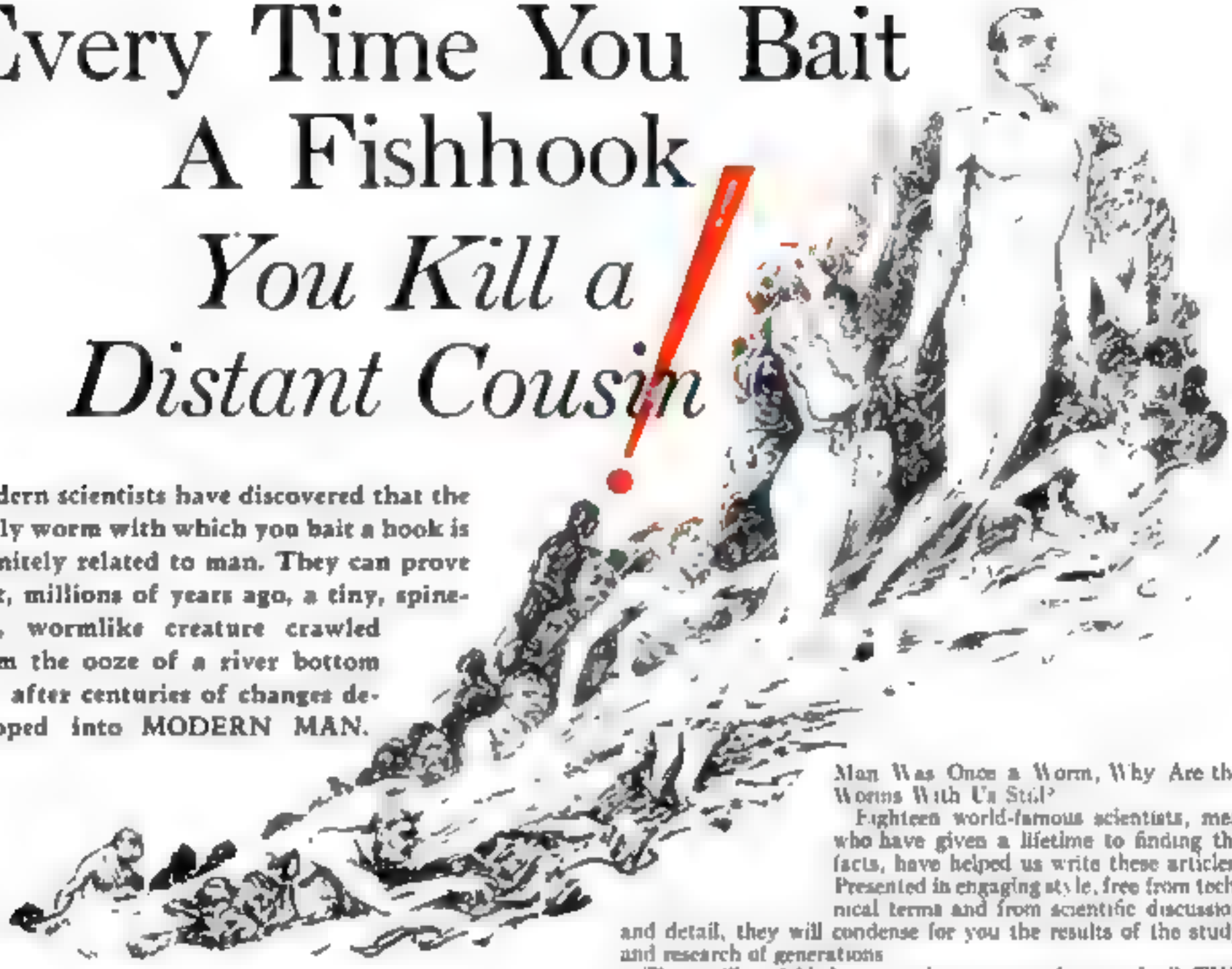
A patient who desires attention merely presses a push button lying on the bed near at hand. The nurse, sitting in another room before a signal board, sees a light flash and hears a buzz. She lifts a telephone receiver and is in instant communication with the patient

The patient talks in a natural voice without effort toward a microphone in a [illegible]. It is so sensi[illegible] heard every[illegible]



As the patient presses a button on the bedside stand, the nurse, upper left, sees a signal on the board. The two can then talk over microphone and loudspeaker

Every Time You Bait A Fishhook *You Kill a Distant Cousin*



Modern scientists have discovered that the lowly worm with which you bait a hook is definitely related to man. They can prove that, millions of years ago, a tiny, spineless, wormlike creature crawled from the ooze of a river bottom and after centuries of changes developed into MODERN MAN.

WE WILL TELL YOU HOW SCIENCE HAS SOLVED THE MYSTERY OF LIFE!

NEXT month POPULAR SCIENCE MONTHLY begins the publication of a remarkable series of articles that reveal all of the latest scientific findings concerning man, his life on earth, and his debt to the past.

18 Famous Scientists Helped Us Write These Articles

These articles will be sensational because they will tell you things about yourself that you never before suspected and answer questions you have asked yourself for years: Why Am I Alive? Why Must I Die? Why Do I Look Like My Mother While My Brother Looks Like My Father? If Man Was Once a Worm, Why Are the Worms With Us Still?

Eighteen world-famous scientists, men who have given a lifetime to finding the facts, have helped us write these articles. Presented in engaging style, free from technical terms and from scientific discussion and detail, they will condense for you the results of the study and research of generations.

They will unfold for you the greatest drama of all, THE DRAMA OF LIFE ITSELF. In this the Stage is the Earth, the Hero is Man, Death is the Villain.

In the first act you will see how man evolved from the little crawling worm and how this creature itself developed from a tiny cell ancestor of all living things. Then the action will reveal swiftly Man's growth and the development of his Civilization. Later will be told the amazing story of

YOUR BODY AND YOUR MIND

Here is the most wonderful piece of machinery in existence. You will want to know the latest scientific facts about it, facts that you can use, told in language that you can understand.

The whole story is more fascinating, more dramatic than any fiction possibly could be. But the series will be more to you than a thrilling wonder story. It will be an education in itself. It gives the facts of modern science unearthed in rocks, found in test tubes, glimpsed in the lenses of microscopes, revealed by the penetrating power of X-rays.

It will be the most authoritative and at the same time the most thrilling series of articles we have ever published.

Read the Facts in June POPULAR SCIENCE *Monthly*

BIG MODEL OF GLIDER FLIES 32 MINUTES

A model glider that Martin Moad, Los Angeles, Calif., high school boy, built recently gave him a four-mile chase over hill and dale. When he launched it with a rubber cord from a 450-foot hill, it breasted rising air currents so successfully that a long straightaway pursuit followed before Moad could recover the model.

Measuring thirteen feet in wing spread, the remarkable model may be the world's biggest. It has made a number of long flights, remaining in the air on one occasion for thirty-two minutes over an arroyo.

Martin Moad, Los Angeles high school boy, who built a large glider model that flew for 32 minutes

COLORED SNOW MYSTERY AT LAST EXPLAINED

Yellow, black, red, and green snow are curiosities reported from many parts of the earth, belying the familiar phrase "white as snow." Long the subject of controversy, the peculiar tints of these forms of snow have been explained by modern science.

Most are caused by the presence of variously colored minute plants, known as algae. Among these are the green snow of the Antarctic and some peaks of the Alps, the black snow of the high mountains of Tatra in Hungary, and the bright yellow snow of the South Orkneys, in New Brunswick. In the latter case the algae contain a large amount of fat, with which is mixed the yellow pigment.

Red snow is the commonest of tinted forms, ranging from a delicate rosy red to a deep blood red. Alpine climbers find it especially prevalent on the slopes of Mt. St. Bernard, it occurs as well in the Arctic regions, in the Russian Carpathians, and in the Andes of South America. Algae again are responsible, though sometimes minerals color snow.

At top, the plaster model of the Radio City, with its designers, and below it plans of proposed center

BIG RADIO CITY SHOWN MODELED IN PLASTER

[illegible] workmen [illegible] greatest [illegible] undertaken in America—New York's $250,000,000 Radio City, financed by John D. Rockefeller, Jr. By the fall of 1933 they will have completed what will be a center of music, opera, and radio and television [illegible].

A plaster model showing what the finished "city" of buff-colored pinnacles will look like was exhibited recently in New York. Already architects are applying the finishing touches to plans whose preliminary form was revealed in our September, 1930, issue; clearing the site has begun.

TIRE CHAINS PUT ON AUTOMATICALLY

[illegible] handle. This [illegible] miles. The end of the chain is a clamp that instantly grips the tire and revolves with it, drawing along the rest of the chain. A [illegible]

Above, [illegible] never near the emergency brake [illegible] of which [illegible] actually on the rear wheels of car. As it [illegible] hook is seen partly around the wheel and coming from the running board.

SOLDIERS AT BASEBALL WEAR GAS MASKS

Everyone but the umpire wore a gas mask, when soldiers at Fort Wayne, Mich., recently staged a baseball game. Officers here have adopted a novel policy to accustom the men to the feel of the respirators. They are required to wear the devices when playing games, so that they will become used to breathing through them under the strain of wartime battles, and hence will be less likely to expose themselves to serious poisoning in an effort to escape momentarily from the restraint of the mask.

PORTABLE BERRY BEDS

Visitors to Florida may now rent their own strawberry patches for the season. The "canned" strawberry beds are delivered in concrete troughs four or five wide, with a low rim so that they may hold water.

Each plant is set in a small can with holes punched in the bottom in order to allow water to get at the roots.

POCKET SIZED DEVICE TESTS AUTO BRAKES

Three small steel balls rolling in inverted "V" slots of different slopes in a piece of cardboard allow a motorist to test his brakes without leaving the wheel. The tester is placed level and parallel to the side of the car. With the car going twenty miles an hour, the brakes are suddenly applied. This throws the balls forward. Good brakes cause all three to mount the inclines. Poorer brakes move only one or two.

The movements of the balls in this simple device give an accurate idea of the state of car's brakes.

CUBANS USE PALM LEAVES AS 'CHUTES

Long before aviators thought of leaping with parachutes, fearless Cuban natives invented a substitute to speed their descent from the tops of royal palm trees.

Here the camera man snapped a remarkable picture of one of them, Pepe Garcia, as he takes the air in a seventy-five-foot drop, clutching a bundle of palm fronds. They serve the same purpose as a 'chute, slowing his fall and breaking the shock of landing.

Useful tools are these improvised parachutes, for the royal palms supply thatch for the native's roof, utensils for his kitchen, preserved delicacies, and lumber for his hut, as well as furnishing him a ready means of getting back to earth from a tree top.

NEW TRUCK DESIGNED TO LAY ITS OWN ROAD

Roads unrolled from a spool—that is the dream of Benjamin F. Morningstar, Park Ridge, N. J., inventor. Recently he exhibited a model of a truck he has designed which could lay a 100-foot section of continuous road in two minutes across a swamp. It would replace a military engineer unit of 120 men, would do their work in one-eleventh of the time they would take, and in wartime would expose only one man instead of 120 to enemy fire.

The portable road is a roll of wooden planks, joined by hooks and carried in a spool on the truck. To lay it, the truck would maneuver into position and then back across the swamp, laying its own road as it went. Such a truck, Morningstar says, could be built for $1,000. He has submitted plans of his invention to the U. S. War Department and to foreign governments.

This truck carries its own road with it and can back across a swamp and lay one hundred yards of road and then go for more.

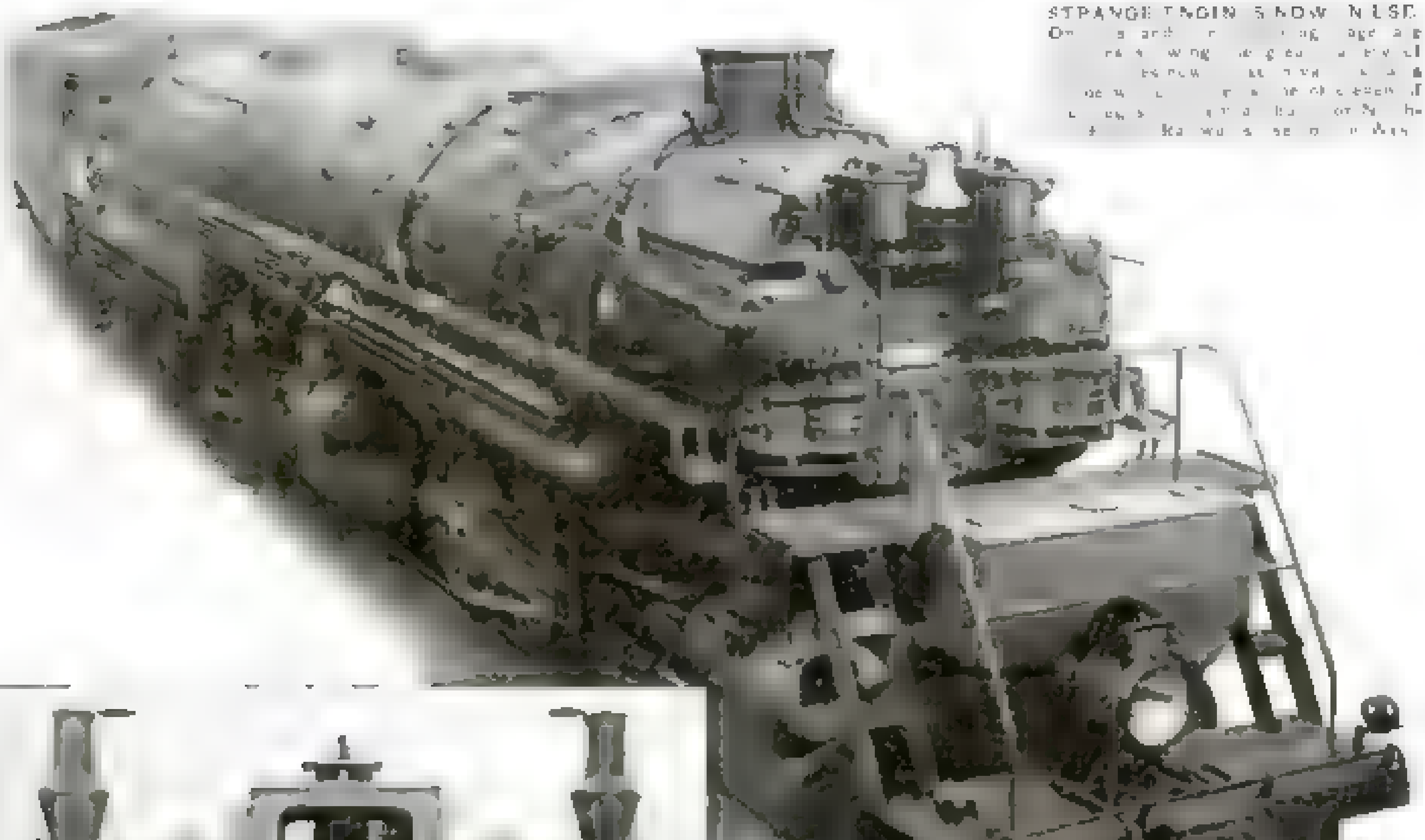
STRANGE IDIOMS IN MOVIE LANGUAGE

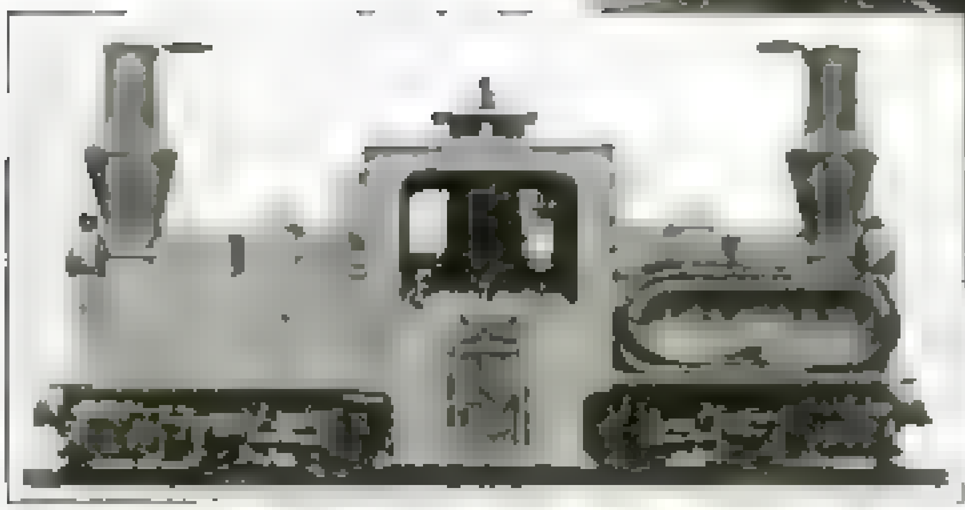
Don't be alarmed if you visit a movie studio and are warned to look out for the dynamite. It doesn't mean high explosive. According to a glossary of movie terms compiled by the Academy of Motion Picture Arts and Sciences, it refers to "an open connection box into which the studio lamps are plugged—dangerous if stepped on."

"Canaries" are unidentified high-pitched noises in the sound recording system. A "bug" is defined as an insect that flies across the set while a scene is being photographed, usually spoiling it. In the same curious argot "the baby is lost" means "the small spotlight is not functioning." "Oscar" is slang for oscillations. Pulsations in intensity of sound are "whissers."

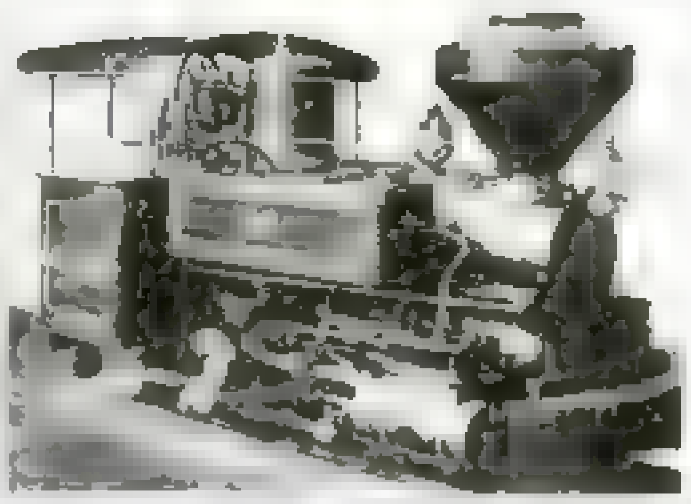
Big and Little Kings of the Rail

STRANGE ENGINES NOW IN USE. [illegible]

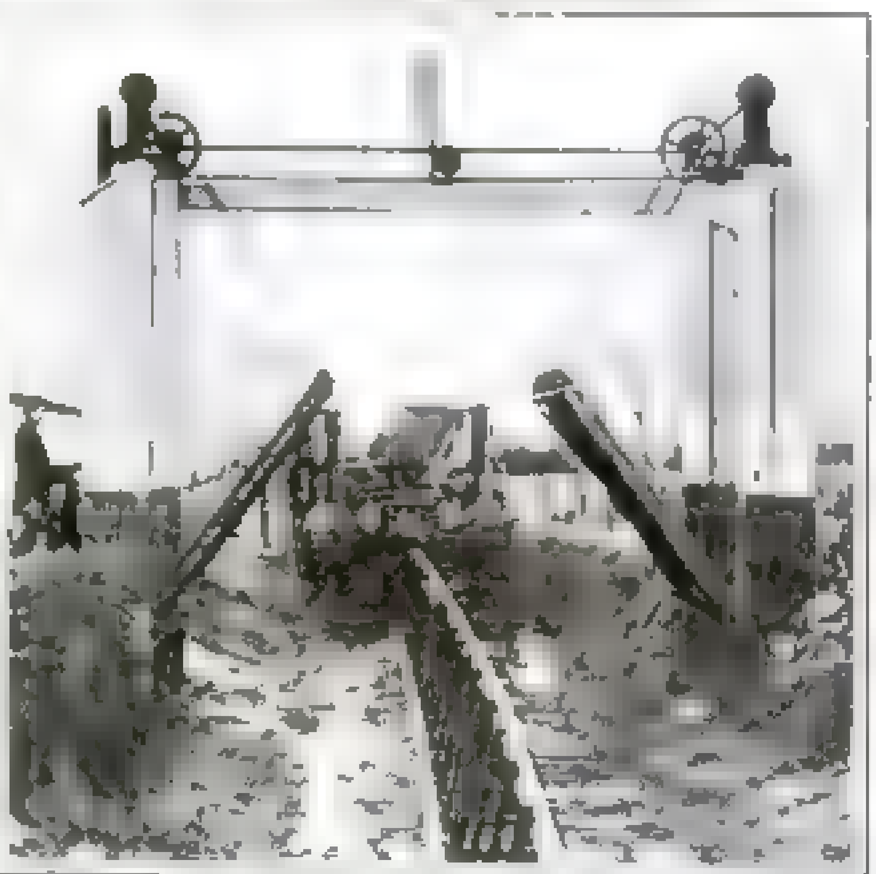




BORN WITH TWO HEADS. [illegible] two-way [illegible] new service [illegible]



FOR HAULING LOGS. [illegible] and burns soft coal.

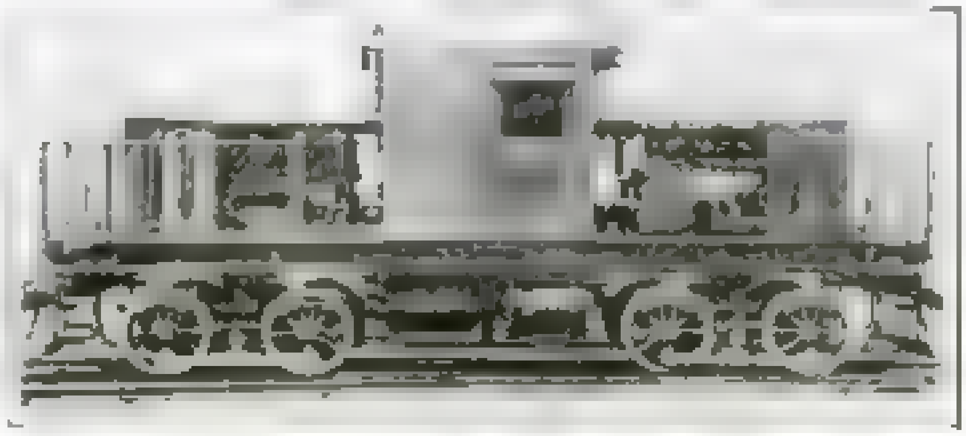


[illegible] TAINS. [illegible] tender are all one.

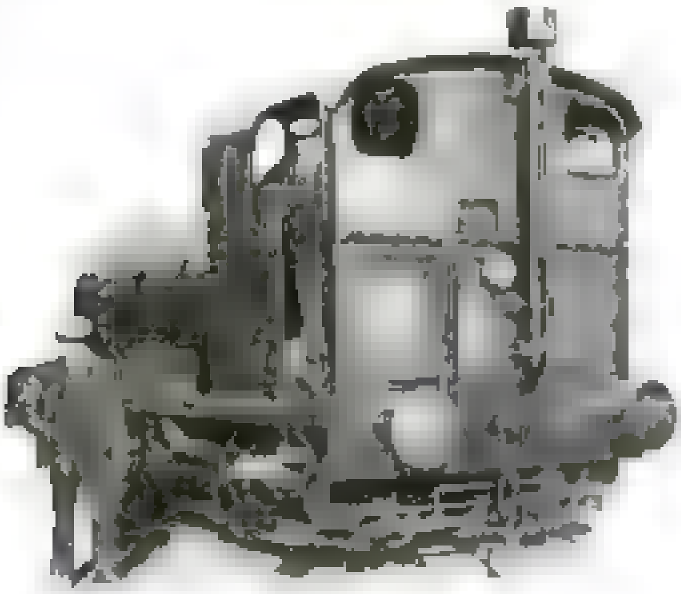
[illegible] The [illegible] The engine has two boilers and two smokestacks. Notice the drawbridge over rail.

HOW INDIA DOES IT. T[illegible]

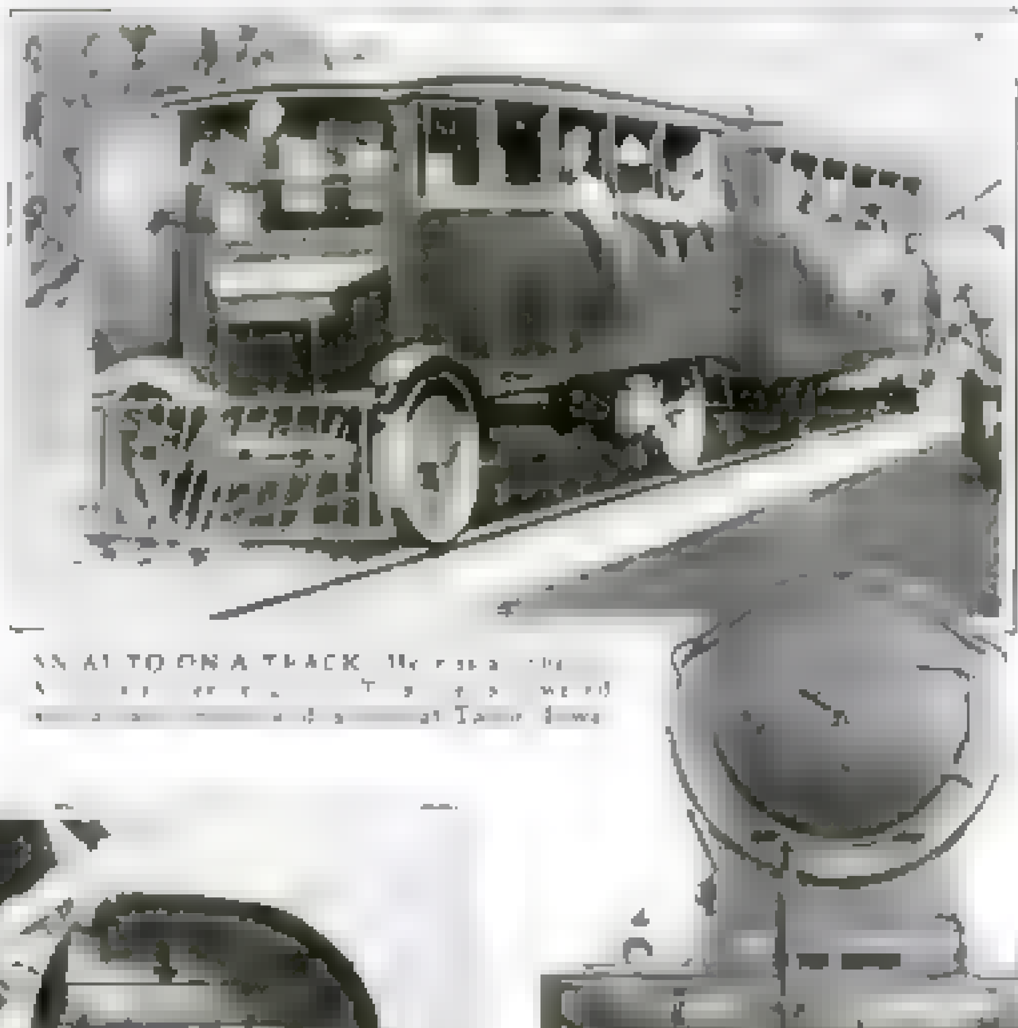
GUARDED FROM FURNACE BLASTS. Heat resisting glass in the windows of this Diesel-electric locomotive for steel plants protects the engineer when he passes [illegible]



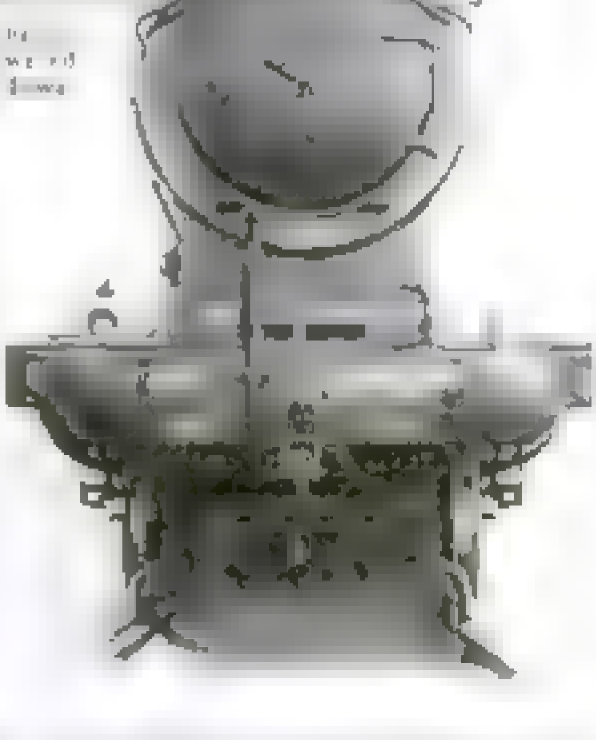
PULLS EIGHTY CARS. The strange engine above [illegible] just such big jobs



STEAM BUT NO FIREBOX. [illegible]



AN AUTO ON A TRACK. [illegible] at Tama, Iowa



ENGLAND'S [illegible] England. [illegible] here at the head of a fast express passenger train. [illegible] City of Ripon [illegible] makes 90 miles an hour

LETTER PUT ON AIR BY RADIO TYPEWRITER

IN A DETROIT hotel the other day engineers gathered to watch a demonstration of one of the latest wonders of radio, a typewriter which sent typed letters through the air without the aid of wires. At the receiving end they are automatically reproduced upon a typewriter without the touch of a human hand. Glenn W Watson, radio engineer, stood before the device which he perfected.

It resembled an electric motor connected to a typewriter keyboard. The keys were pressed, making contact with a revolving disk. A similar revolving disk on the receiving set carries letters of the alphabet Thus a letter was sent through hundreds of miles of space. The secret lies in operating both disks so that they keep in step with each other

The only limit to the speed of this apparatus is the ability of the operator to work its keyboard. It is expected that it will prove a benefit in sending police messages, since it will transmit typed letters secretly without using codes.

BAKE STEEL BISCUITS IN HEAT TEST

STEEL "biscuits" were baked in ordinary biscuit pans as a test in San Francisco the other day before a group of metallurgical experts. Unlike the biscuits that mother makes, which are all from the same batch of dough, each of the steel biscuits was made from a different mixture of metal. The object of the test was to find out how the different alloys were affected by exactly the same amount of heat

The biscuit like things above of steel dough, were baked in a heat-testing experiment.

GIANT TELESCOPE SITE TO BE CHOSEN SOON

AUTHORITIES at the Mount Wilson Observatory, California, soon may announce the site for the huge new 200-inch telescope now under construction. The big telescope must be placed on a mountain top, with plenty of clear air around it. It must be in a position where there is little wind and where there is a relatively slight change in temperature during the day and night

ONE MAN CAN LIFT A TELEGRAPH POLE

ONE man can easily lift a 2,000-pound telegraph pole with a jack recently developed by a California power company. When he swings the handle a worm-and-gear drive elevates the lifting arm. The base is so large that it may be used on soft or uneven ground.

QUEER SLOTTED SHIELD FITS HEADLIGHT BULB

ALL sorts of shields have been designed to fit over the bulb in the automobile headlight with the object of cutting down the glare. Here is a novel type fitted with a horizontally slotted spherical front piece that allows some of the light to reach the road directly in front of the car

A separate section covers the top section of the bulb. This portion is perforated to permit pencils of light to strike the upper section of the reflector. It is claimed by the inventor that this simple little device makes special lenses of prismatic or frosted design unnecessary if the headlight is properly aimed and focused.

The device was recently demonstrated successfully by its inventor, William A. Benson, before a group of newspaper men at Jamaica, N Y

WINDOW SHOWS HOW JURORS ARE CHOSEN

Not everyone called to serve on a jury knows just how his name happened to be chosen. The illustration shows how names, written on slips of paper, are tumbled in a revolving wheel-like cage and then drawn one by one

An innovation in this particular machine was the idea of jury commissioners of Cuyahoga County, Ohio.

Tiring of complaints that the jury-selecting wheel was fixed so that certain names fell into hidden pockets, they put a large glass window in one side. Now observers can watch the whirling slips and make sure

A window in this revolving box from which the jury is drawn shows how choice is made

HELICOPTER RAILWAY RUNS IN FRANCE

ODDEST of railway cars is a vehicle that speeds at fifty miles an hour along a private railway near Paris, France. It carries models of helicopters, or vertical-flying aircraft, to be tested for their lifting power and stability

The user of this strange equipment is Louis Damblanc, French aeronautical engineer who for years has predicted the ultimate triumph of the helicopter over conventional airplanes. His unique railway, the only one of its kind in the world, is installed near a [illegible] laboratory where he [illegible] this type of craft. It is nearly a mile long and extra guide rails steady the speeding car with its precious model

Air speed meters are mounted on the railway car to measure and record the wind currents while the behavior of the model is watched. Thus the railway takes the place of a "wind tunnel" commonly used for tests, in which a model is mounted

France has the strangest railway in the world, a fifty-to-an hour helicopter affair

DOOR OF NEW TRUCK FORMS GANGWAY

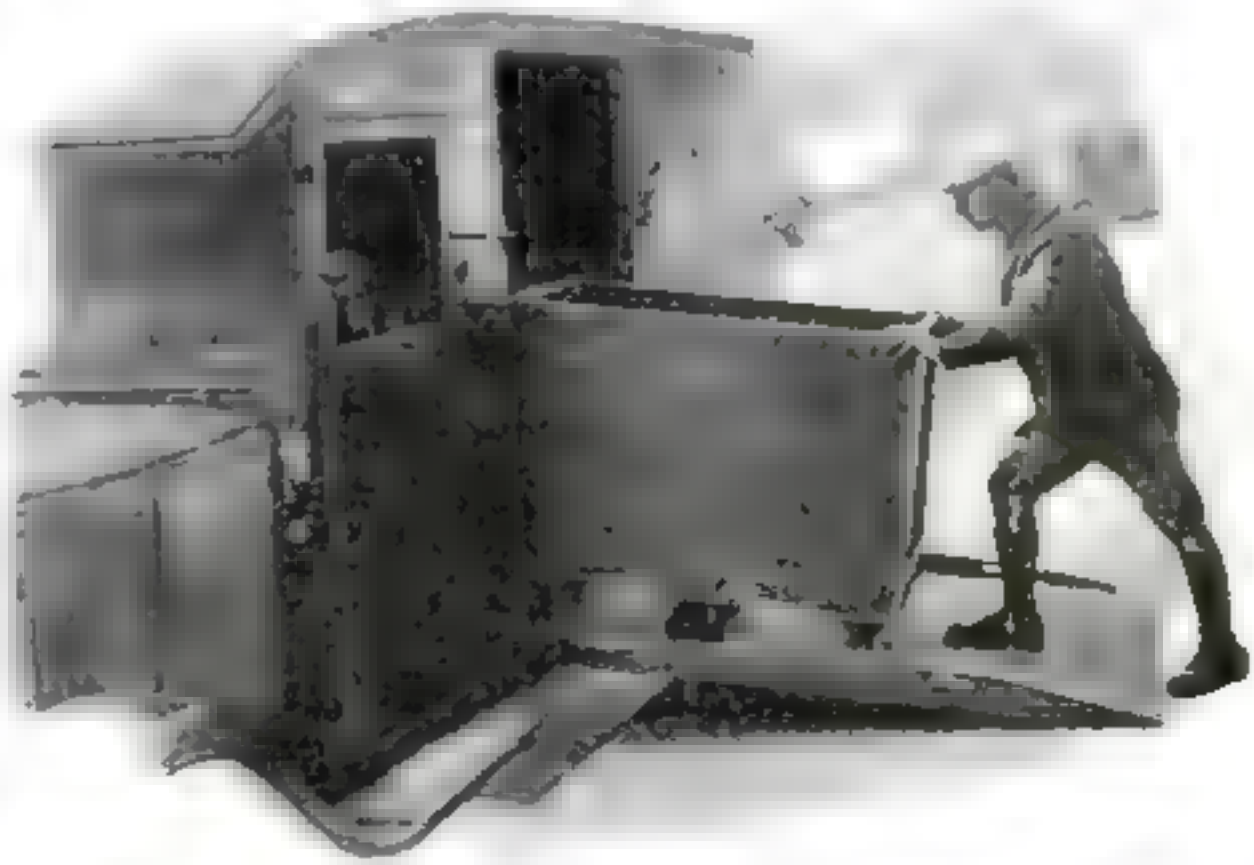
A TRUCK body recently developed by a Portland, Ore., department store makes loading easy and relieves traffic congestion Side doors open downward, forming a gangway from the sidewalk. Loaded hand trucks are pushed up this inclined runway and remain in the delivery truck when it goes out on its route. The hand trucks are filled in the shipping department, so no time is lost at the curb

USE LIE DETECTOR IN MURDER CASE

Dr Larson exhibits record made by lie detector when accused murderer was questioned.

JUST how a "lie detector" traps the prevaricating criminal was strikingly shown not long ago when the Illinois State Criminologist, Dr John A. Larson, obtained permission to try the device upon a Chinaman accused of murder

This type of machine, developed at the University of Chicago, makes a chart of a suspect's pulse and breathing while he is being questioned. After having denied the crime and all knowledge of it for sixteen minutes the Chinaman was suddenly accused of it again. This time he again protested his innocence—but the narrower wavy line showing his heartbeats, gave a tell-tale trap. His confession followed.



The side doors on this specially built automobile truck body form a gangway for quick loading at the curb when lowered to the ground as shown above, thus relieving traffic congestion.

Dead Wells *Made to* Spout Oil

Gas and Oil Pumped into Exhausted Fields Start New Flow of Liquid Gold

By STERLING GLEASON

Pulling the bit out of one of the deepest oil wells in the world. When dry pumping oil and gas into this hole may start it flowing

Air view of oil tank farm. Storage tanks such as these cost from thirty to seventy-five cents a barrel to build

AN OLD oil field, almost exhausted by a quarter century of draining, has just sprung into the spotlight by suddenly yielding a heavy flow of high gravity oil.

Ancient wells whose output had dwindled to a mere trickle of oil from a sluggish pump have astounded oil experts by beginning to flow at the rate of several hundred barrels of thirty-two-degree oil a day.

Through a revolutionary process developed by engineers of the Union Oil Company, the Brea-Olinda field, near Los Angeles, has been brought to new life under a system that flushes depleted oil sands and brings out the residue of oil that previously had been considered lost.

By utilizing underground reservoirs created by Nature millions of years ago geologists are now turning surplus oil and gas back into the ground, reversing the usual methods of production. The present huge flush production resulting from the development of new fields such as the Oklahoma and New Mexico regions has taxed the storage capacity of mammoth modern tank farms like the one above.

By the new system, geologists have solved the vexing problem of how to store cheaply this tremendous excess production which is threatening the stability of the world petroleum market. At the same time they are increasing the percentage of oil that will eventually be extracted from the earth, making possible the recovery of many thousands of barrels that would otherwise be wasted.

WHEN a program of deepening wells at Santa Fe Springs, Calif., led recently to a tremendously increased production from newly tapped high-pressure oil strata, engineers of the Union Oil Company were faced with the problem of storing this heavy flow until it could be used. The oil had to be taken from the ground, because of lease agreement. Union's huge storage reservoirs and tank farms were already full. To dump the oil on the market spelled ruin to the entire industry.

Engineers began to experiment with underground storage. Depleted oil zones had been used previously for storage of gas, so why not for oil? One engineer suggested that if Santa Fe Springs oil, with its high gasoline content, were turned into an old field which was known to hold heavier oil, the lighter oil would dissolve the heavier, making it less viscous and allowing it to flow more readily through the sands.

OTHER geologists dissented. They predicted large losses, pointing out that in most fields more than half of the oil below ground is never recovered, largely because the natural gas pressure soon diminishes to a point where it is unable to lift the petroleum to the surface, even with the aid of a pump. But the engineers devised the scheme of injecting natural gas, as well as oil, into the old strata, thus automatically insuring a satisfactory gas lift. They set about proving their theories.

Pipe lines were run from Santa Fe Springs to Brea. All wells on the property were shut in except four that had been selected for the test. Pumps forced oil down the casings of three of them under a pressure of 900 pounds to the square inch. High pressure natural gas flowed down the fourth. The wells receiving oil and gas were rotated so as to get an even distribution.

When half a million barrels of oil and 600,000,000 cubic feet of gas had been injected into the ground, engineers opened the wells for a production test. To their intense gratification, oil rushed up through the pipes at the rate of several hundred barrels a day. Analysis revealed that the gravity was thirty-two degrees. The

experimenters were jubilant, for this proved that the thirty-four-degree oil injected into the well had dissolved an appreciable quantity of the heavy seventeen-degree crude that years of pumping had been unable to draw out

UNION engineers next ran pipe lines ten miles from the Orcutt field, near Los Angeles, to wells in the Lompoc field, whose production had dwindled to a feeble flow of nineteen-degree crude. They injected 250,000 barrels of twenty-two-degree oil and 321,000,000 cubic feet of gas. In order to dilute the heavy oil still further, they added natural gasoline until the gravity reached twenty-eight degrees

A sensational increase in production immediately corroborated their theories, definitely proving that much more oil than was injected will eventually be extracted

Meanwhile, in other fields, engineers are utilizing subterranean caverns in place of immense gas storage tanks which cost $75 for each thousand cubic feet of gas they hold, or many times the value of the gas itself. Thus they are solving one of the knottiest problems of the gas industry, that of equalizing the supply and demand from hour to hour and from week to week.

WHEN the weather turns cold and you light your gas heater or furnace, you are helping create a peak demand for gas that may be many times greater than the load at slack periods. Experts have estimated that in southern California alone the demands of consumers vary as much as [illegible] cubic feet a day

Heretofore much of this gas has been blown off into the air. But geologists are now using whole fields of oil wells for storage of this excess gas. Approximately 50,000,000 cubic feet a day are being stored in certain California fields.

The production of gas is subject to huge fluctuations. When the famous Signal Hill, Santa Fe Springs, and Huntington Beach fields reached their peak of production simultaneously, the production of natural gas rose to over 1,000,000,000 cubic feet daily although ten months before the flow had been only one third as great

This use of underground reservoirs for oil may make obsolete the "farms" of huge steel tanks that now dot the country near the oil fields. One such tank at Watson, Calif., holds 158,000 barrels. Engineers have devised enormous earthen storage reservoirs of from one to four million barrel capacity but (Continued on page 125)

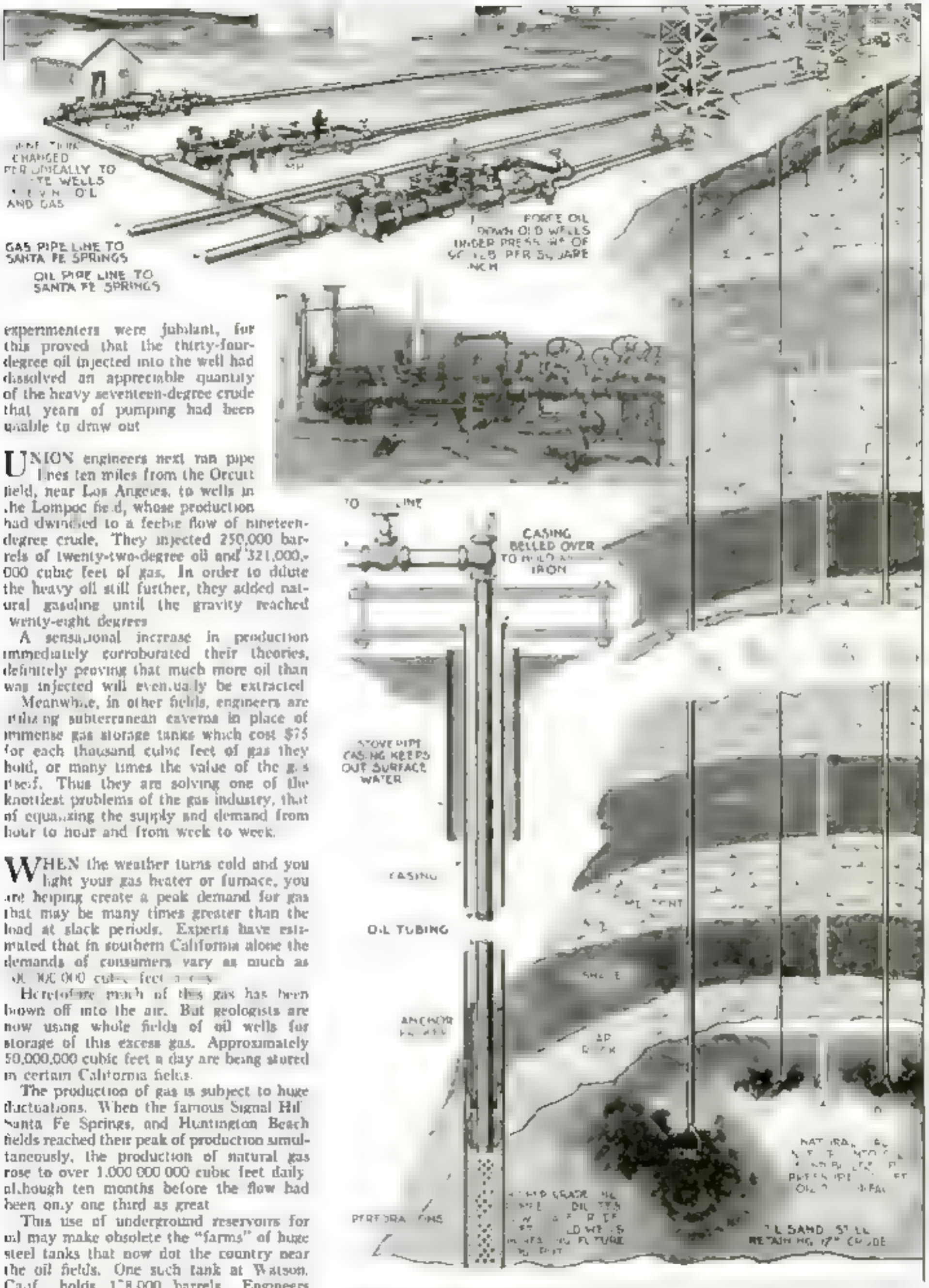


Diagram of earth's strata in an oil field showing how a reserve supply of oil from which gas pressure has been removed, can be forced out if gas and oil are pumped down upon it. Inset at right is photo of a pump used in California to build up the pressure needed to force oil into the ground. At left, immediately above, is detail of pump joint showing how oil is forced into the well

Costly Nuisances Yield Riches

Miracles of Change in the Industrial World Show How By-products That Caused Big Losses Have Been Transformed into Valuable Assets by Work of an Army of Chemists

By JESSE F. GELDERS

BELGIUM'S mysterious poison fog is no longer a mystery. The source of its death-dealing fumes, which claimed seventy human victims and a large number of cattle, has been traced to near-by factories from which sulphurous fumes escaped. It is assumed, in the absence of definite proof, that this gas combined with the fog to form an acid that ate at lung cells with fatal results.

This death fog made everybody nervous, the hysterical explanations poured in. Deadly germs, poisons dormant since the war, and the falling of deadly gas out of interstellar space were some of the causes assigned for it. In reality it seems to have been nothing so romantic as any of these. Just factory fumes. Nor is this the first time that factories have poured poison into the air.

Often in the past noxious by-products have raised hob with vegetation, cattle and human health. Generally, in the end, these harmful wastes have been not only controlled, but coined into gold. The history of industrialism is full of just such instances.

Some years ago copper refineries were releasing great volumes of sulphur dioxide into the air. The fumes killed all vegetation over wide areas.

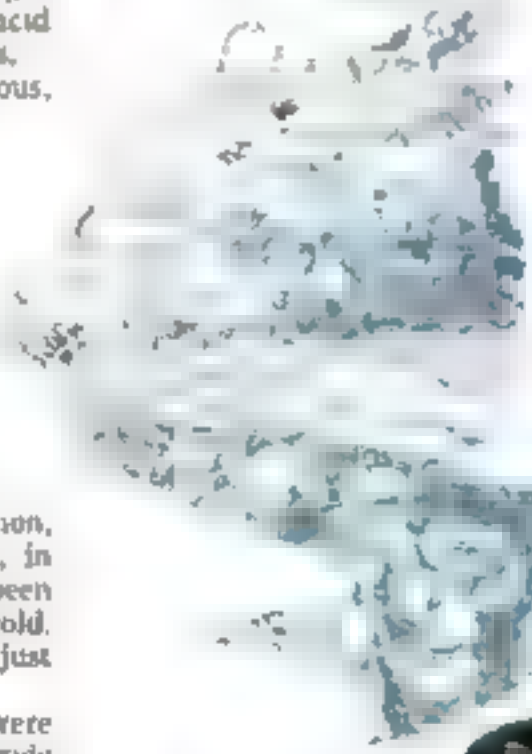
Farmers protested and the refineries engaged lawyers who were kept busy adjusting damage claims.

Finally law and public opinion forced the industry to end the nuisance. The refineries installed equipment to use the gas to make sulphuric acid.

This had many commercial uses, but it became so plentiful that the price dropped, and it was unprofitable. Chemical engineers went to work again. They shipped in phosphate rock, and with the sulphuric acid they made acid phosphate which is one of the three essential ingredients in agricultural fertilizers.

By this process, *the same fumes which formerly destroyed crops were employed to make them grow more luxuriantly.*

The nuisances of industry that have



At upper left, czar's crown made of platinum to save silver bars. Above, fake "gold" coin of platinum. Note scratches made in test.

Chlorine gas, once a destructive by-product of industry, was used as a deadly poison gas in the World War and is now widely used as above, to purify water.

Oat hulls were formerly just so much waste and the only question was how to get rid of them. Now they are converted into lacquer which is used to give the finish seen on the radio parts above.

been conquered and turned to great value make an endless list. Not only material substances, but forces which previously were little understood or uncontrolled are being harnessed to service

Curious reversals of values abound in industry

ABOUT a hundred years ago, many wells were dug for brine, to make salt, in Pennsylvania, Ohio, West Virginia Tennessee, and Kentucky. Much annoyance was caused by the appearance of oil in some of the wells

Oil had a limited use as a medicine and as a not-very-satisfactory illuminant but this was small consolation when p

[illegible]

Pennsylvania took some of the bothersome oil to a Pittsburgh cotton mill, where is was found that it could be mixed with sperm oil for lubricating spindles. It was used in secret for ten years, the owner of the well supplying two barrels a week. Other salt operators developed markets for the waste petroleum, as medicine and lamp oil

It was the demand created in this way which caused the first well to be drilled for petroleum itself, near Titusville, Pa., in 1858.

The production in the United States now is nearly a billion barrels a year

Early in the industry's development, refiners met an annoying problem. In converting the petroleum into kerosene and other useful substances, they extracted a rather explosive fluid for which there was practically no market

FAILING to sell it, they had trouble in throwing it away They poured it out upon the ground, and into rivers, where it became a serious menace. Frequently it caught fire. At one time the Delaware River was aflame for three miles.

Forbidden to dump the liquid, refiners did not know what to do with it. They know what to do with it today. They sell it to motorists. It is gasoline.

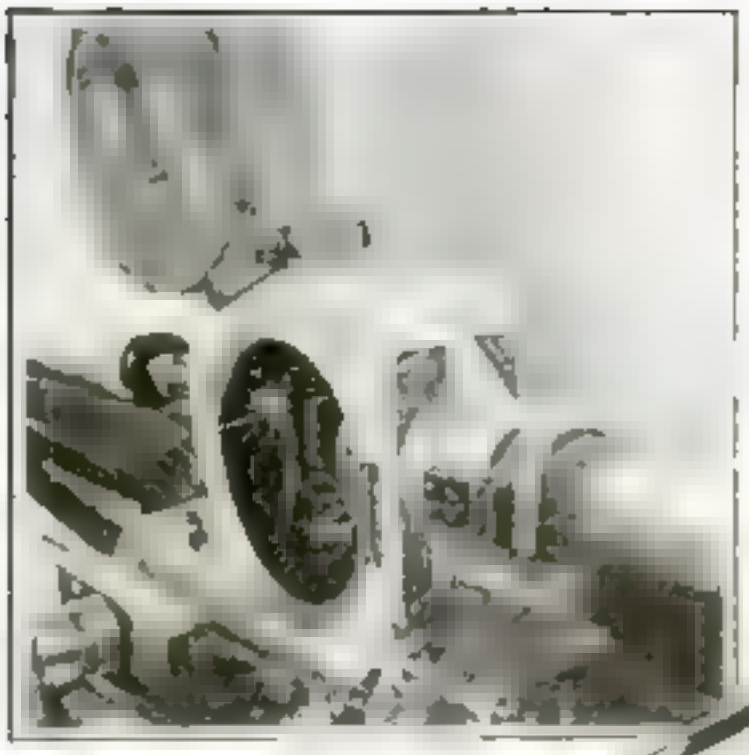
Formerly skimmed milk was simply dumped [illegible] Now many things are made [illegible]

At right persons [illegible] the objects on desk are made from a fat extract formerly thrown away as worthless.

In 1899, when a barrel of petroleum was refined more than half the volume of the finished products was kerosene. Only an eighth was gasoline. Now they turn out seven or eight times as much gasoline as kerosene. Of the total volume of refinery output, about forty percent is gasoline

No longer does the industry permit the demand for one product to blind it to the value of others. After gasoline has been extracted from the crude oil, the residue is made to yield substances with scores, perhaps hundreds, of uses, ranging from medicine to paving asphalt

In many cases this residue is put through a chemical process by which hydrogen is added—*to make more gasoline.* There is one enthusiastic plan to carry out this "hydrogenation" until one gallon of crude oil, with hydrogen added makes more *(Continued on page 74)*



This German developed camera makes a motion picture of the inside of pipes

At right, diagram shows arrangement of parts in camera that makes a picture of the inside of a length of pipe. Its speed is geared to suit the amount of light

At end of the frame supporting the camera rails is a roller support for observation tube.

CAMERA FILMS INSIDE OF PIPES AND GUNS

MAKING a motion picture camera peer into small deep holes and record the condition of their inner surfaces is the achievement of German engineers. They developed a "pipe camera" for this purpose as an aid in inspecting the inside surfaces of pipes and gun barrels. The camera is mounted at one end of a tube almost fifteen feet long. This is fitted with feeding gear and mounted on a framework resembling the carriage of a traveling crane. The drawing above shows a pipe under examination; photo to its left shows the camera and that to the right the eyepiece.

The other end of the tube contains the lens and a small powerful lamp for illumination. It is fed into the hole and film run through the camera at a speed proportionate to the speed of the feed. An arrangement of reflecting lenses like a periscope in the tube enables the camera to make a picture showing the entire circumference of the bore on each film.

To insure correct time of exposure necessary for the film two or three minutes are required for the camera to travel approximately a yard. By special electrical switches, the backward run of the [illegible] at a much higher speed than the forward trip. The time for exposure on the film can be regulated accurately [illegible]

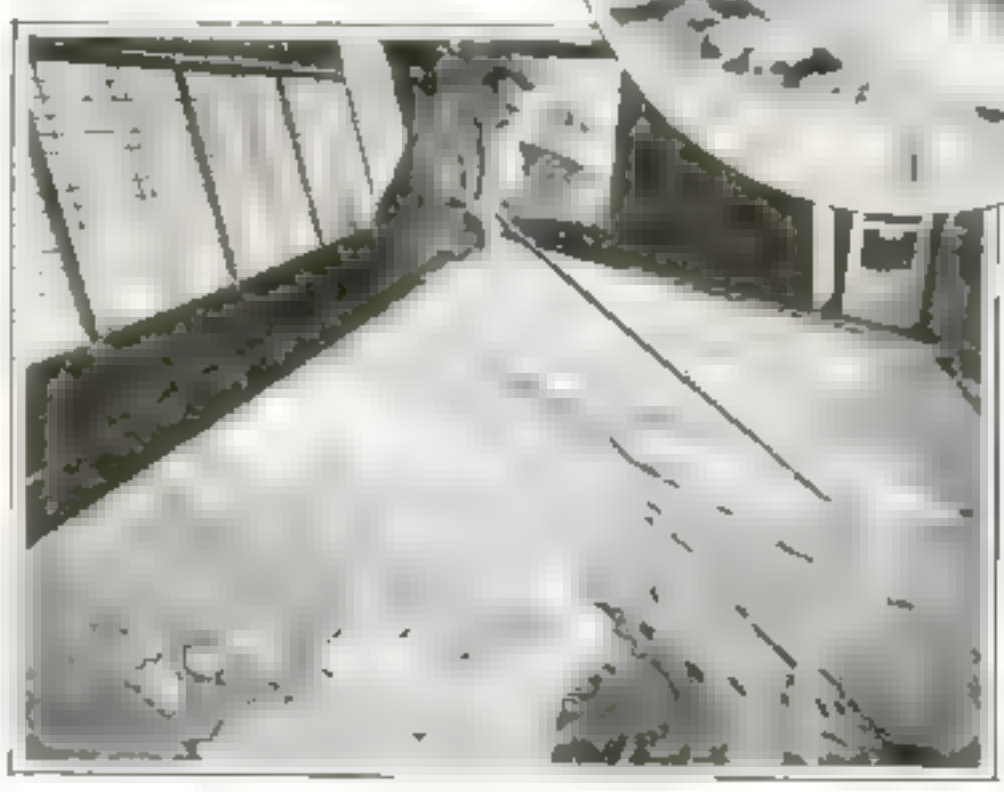
This method [illegible] deep holes [illegible] which left no [illegible] inspected and was [illegible]

LINERS SHOWN ON MODEL OCEAN

TINY steamers are pushed over a huge brightly-painted relief map of the world in a show window of a steamship company in Berlin, Germany. By this mechanical means the passers-by are shown the location of each of the company's vessels on the ocean highways. An attendant stands behind the map and moves the little ships to correspond with latest wireless reports of their positions.

As the models are too small to have their full names painted on them, a huge wall rack behind the attendant carries the ship's name, with a number opposite it. This number is attached to a model which then corresponds to the ship itself.

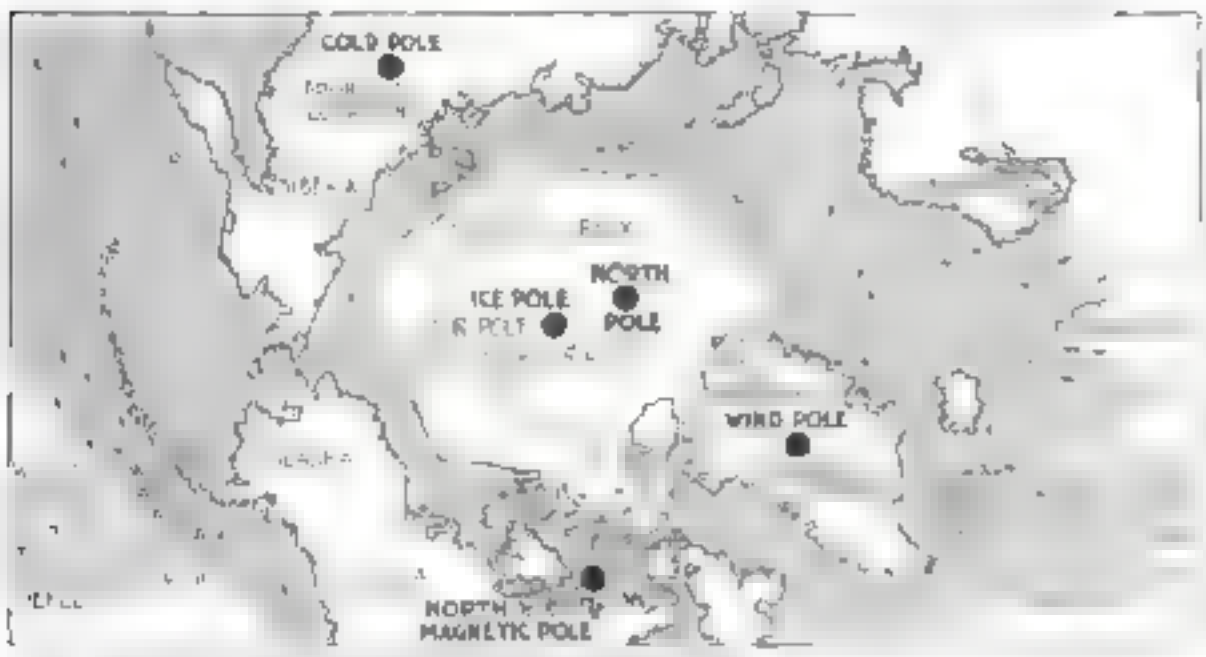
The map gives the interested spectator a good idea of how ships throughout the world keep to certain well-defined routes like traffic in city streets, instead of going wherever their captains feel like taking them. It also suggests the close ship to shore connection made possible by radio.



A [illegible] early [illegible] dated.

A [illegible]

Flyers Make First Air Map of North Magnetic Pole



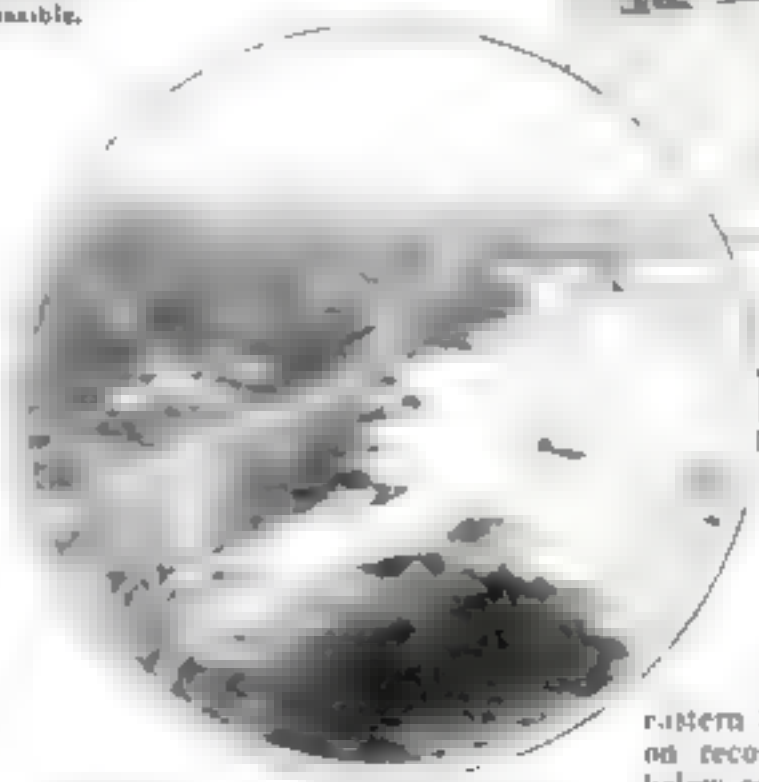
Here are the five poles of the Arctic region. Study of the map will show why the ice pole is practically inaccessible.

W. E. Gilbert as he looked dressed ready for his Magnetic Pole flight.

NOW that the North Pole has been conquered by dog team, airplane and dirigible, northward-bound explorers are turning to less widely-advertised goals. Recently two Canadian government flyers, Major L. T. Burwash and W. E. Gilbert, became the first to reach the little-known North Magnetic Pole by air. Circling 5,000 feet above this spot in northern Canada, they succeeded in making the first aerial photographs of the region.

Compass needles do not point to the North Pole that Peary discovered in 1909. They vary a few degrees from true north because the center of the magnetic force that attracts the north-seeking needle is a spot on the shore of Boothia Peninsula in Canada lapped by the waters of the Arctic Ocean.

This spot, known as the North Magnetic Pole, resembles a bleak Dakota prairie in winter. Summer turns it to a green, grassy lowland. A few Eskimos live in this part of the country. Though not inaccessible, it is grimly inhospitable. Many are the ships that have come to grief on the peninsula's rocky shore. A forced landing in these surroundings might have cost the lives of the daring Canadian aviators. On their way, Major Burwash told POPULAR SCIENCE MONTHLY, they passed over the place where members of the ill-fated Franklin expedition of 1845, seeking a "Northwest Passage," perished while attempting to reach civilization after having abandoned their ships.



This picture of the North Magnetic Pole marked by cross, was made from an airplane.

BUT there is another "pole" far harder to reach—so inaccessible in fact, that no man living or dead has ever stood here. The "Ice Pole," sometimes spoken of as the "Pole of Inaccessibility," lies at the calculated center of the same ice pack that encircles the geographic North Pole and is therefore a most difficult place to get to. No life exists upon it, as far as is known.

Look at a map of the Arctic regions and you will see why this center of the 1,000,000-square-mile ice pack does not coincide with the North Pole. Since the ice pack is set rakishly askew, it extends about twice as far down the Pacific side of the world as it does on the Atlantic. A "warm-water heating system" on the east side causes this.

You will see that the Gulf Stream swings north in the Atlantic, part passing between Greenland and the Scandinavian Peninsula into the Arctic and the rest going south. This pushes the ice over toward the Pacific side, which is much colder, since the warm Japan current is fenced out of the Polar regions by Alaska and the chain of the Aleutian Islands.

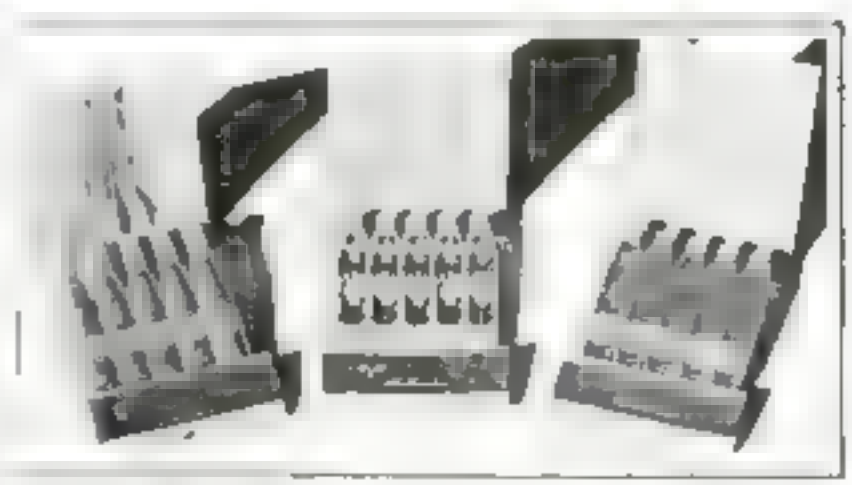
Strange as it may seem, though, the ice pole is not the coldest place in the Arctic regions.

GEOGRAPHERS have tentatively placed this "pole of greatest cold" at the village of Verkhoyansk, about 1,400 miles from the pole in northeastern Siberia. The lowest temperature on record there is ninety-three degrees below zero.

The wind pole, or point at which most of the bitter winter winds of the northern hemisphere originate, is believed to be in Greenland. There is known to be a great elevation in the center of the island, which is very cold. Since the air over this would likewise be thin and cold it would tend to settle and flow down the sides of the elevation, much as you pour water over an inverted bowl. This, then, would be the spot at which the winds start on their end of in the Arctic wastes near the pole, as many people believe.

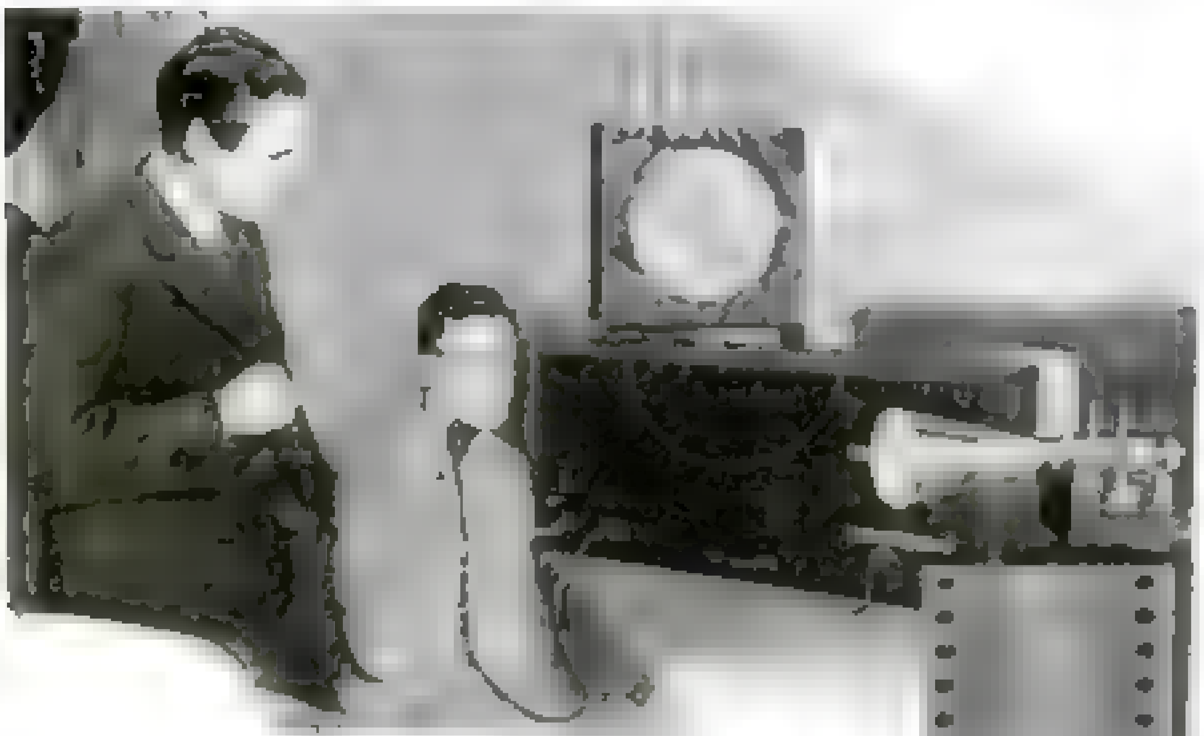
BOOK MATCHES GET STRANGE SHAPES

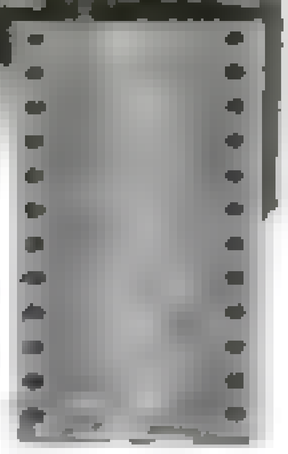
BOOST you will see, if you have not already done so, a new kink in book matches. An ingenious manufacturer recently conceived the idea of shaping the match sticks" themselves to resemble the product whose merits the cover describes. Thus they are shaped to simulate cigars, tooth paste tubes, and bottles of soft drinks according to the needs of the advertiser. A restaurant proprietor had the new matches designed to represent waitresses.



Paper matches now are made in any shape desired by the advertisers. Here they are as cigars, bottles, and waitresses. Almost any business can be thus illustrated.

USE CATHODE RAY TO TEST LUNGS





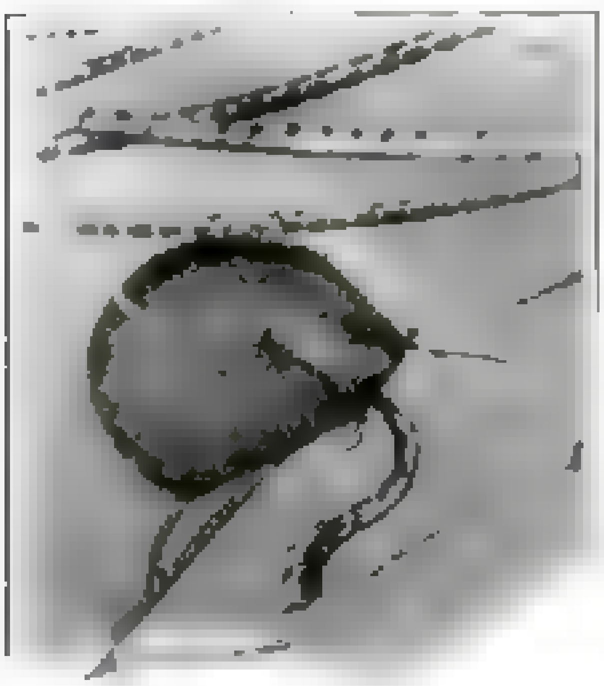
... ction and diag... tr... e made possible by the inven... of ... German physicians. Their new in... resembles a stethoscope, but w... s an electric current take th place of a listening tube. For the physician's ear is substituted the cathode ray which has hitherto been associated with such uses as the measuring of lightning flashes and other high-voltage currents.

In the new lung tester, the beam traces a wavy line of light in response to the patient's breathing. The physician may observe this visually, or obtain a permanent record on a movie film.

TINY ELECTRIC EYE NOW READY FOR AMATEURS

A SMALL cheap photo-electric cell, or electric eye, has been developed by a manufacturing firm in Camden, N. J. This little electrical device has the power to release a current of electricity whenever light strikes it. Although this model has been developed for the use of amateur experimenters, it can be put to many useful tasks.

Anyone with an elementary knowledge of electricity may rig up one of the cells so that it will automatically turn off a night light in the hall when daylight comes—or even with additional equipment, open a garage door at the shadow of a car.



MAGNIFY MINUTE WATER LIFE MILLION TIMES

IF A HALF-INCH cube of water from the average pond were suddenly enlarged to a million times its natural volume, an observer might see with a shock some of the strange creatures that live there. That startling feat of magnification was performed not long ago at the American Museum of Natural History, in New York, where glass models form an exhibit of "rotifers" and other oddities of aquatic life magnified a millionfold.

Rotifers are minute water animals, taking their name from the fact that their movements in swimming resemble a wheel. They are found in greatest abundance in fresh water and a model of one of them is illustrated in the photo above.

TRAPS UP IN THE AIR CAPTURE BUGS

Setting traps for bugs. Government entomologists are using these boxes on poles to capture pests for study.

GOVERNMENT entomologists are now going up in the air to trap insect pests. Their latest device is a wind-vane trap, which keeps its mouth wide open in the direction of the wind to catch insects enroute from their breeding places to sugar-beet fields in the West.

These traps are mounted on high poles at varying heights to discover the air lanes which have most bug traffic. The trap consists of a light wooden box in which there are several screens, arranged like a funnel, and connected with a small jar of cyanide. The insects are blown into the trap and fall into the jar of poison.

By using the traps early in the season, scientists can tell planters how many pests to expect.

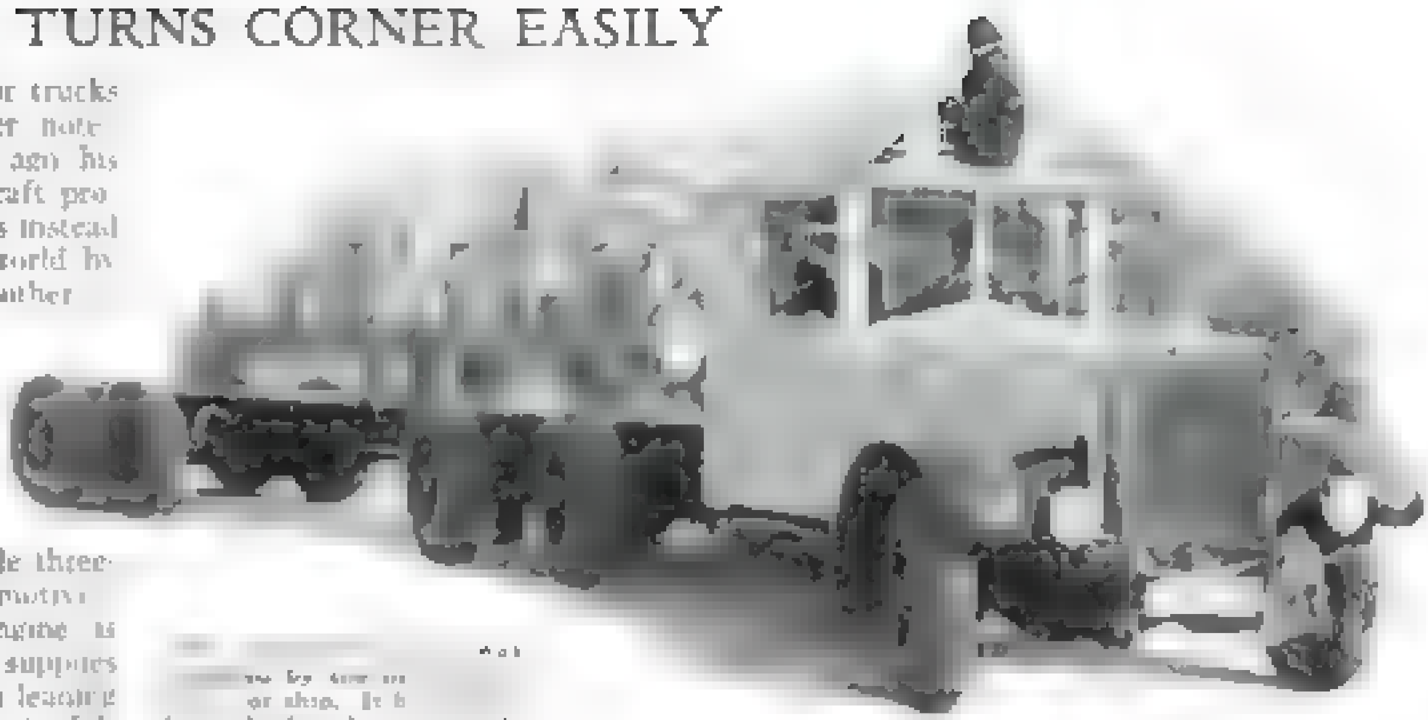
FREIGHT BY WIRE IN COFFEE LAND

SINGING wires of aerial cableways form the chief means of communication between cities of the coffee-growing district of Colombia, in South America. These cities are isolated from each other by mountain ranges and impassable jungles. Airplane lines connect some of them, but planes cannot handle freight in large quantities. At present ninety-six miles of aerial cableways, in all, carry freight and passengers where all other means of transportation have failed.

GIANT TRUCK TURNS CORNER EASILY

From ships to mammoth motor trucks is an easy step for Anton Flettner, noted German inventor. A few years ago his "Flettner rotorship," a strange craft propelled by vertical revolving stacks instead of screws or sails, startled the world by traveling across the Atlantic. Another of his inventions was the "Flettner rudder" for ships which swings freely in response to the turning of a small guide fin.

Now he has built a monster eleven-wheeled truck which embodies the principle of the Flettner ship rudder. A detachable three-wheeled driver's cab or "locomotive" containing the 150-horsepower engine is hinged to the trailing body, and supplies power to its wheels. The trailer's leading wheels, which swing automatically to follow the cab in turning, help the whole truck to get around a corner.



[illegible] ...ed by the [illegible] ... or ship. It h[illegible] big wheels, three on cab

FREE-WINGED PLANE ABLE TO FLY ITSELF

Successfully demonstrating in test flights that it practically can fly itself, land, or take off without the aid of a pilot and cannot stall, spin, sideslip or stunt, a new "free-winged" airplane is scheduled to be produced on large scale by its Los Angeles designer, G. Wilbur Cornelius.

The monoplane differs from orthodox aircraft in that its wings are not rigidly fixed to the fuselage but are free moving, automatically adjusting themselves to air bumps, acting as elevators and ailerons combined.

Attached to the trailing edge of each wing is a paddle-like trigger assembly—stabilators that can be adjusted so the ship will maintain any desired gliding or climbing angle.

All the pilot has to do in landing is to cut off the plane's motor and set the stabilators for the correct gliding angle. The craft is steered by a conventional rudder at the tail, but its free moving wings automatically put the plane in o[illegible] bank while turning.

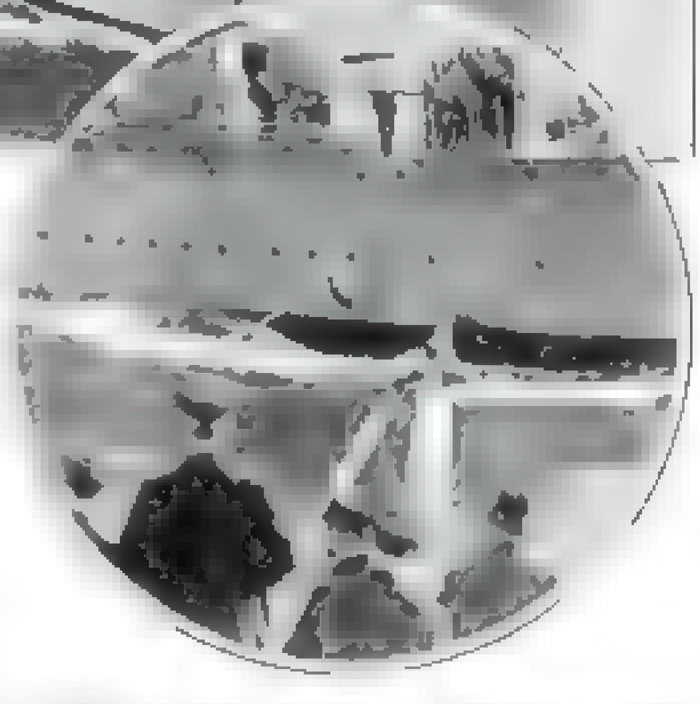
Tests showed that the craft cannot stall because the center of gravity is located so as to cause the wings and stabilators automatically to keep the craft in a position that will not allow it to lose flying speed. The plane can be forced into off center maneuvers, but rights itself to an even flying keel when the pilot takes his hands off the controls.

GUN SHOOTS MAIL FROM SHIP TO SHIP

Shooting mail from one British ship to [illegible]

Mail sometimes starts from [illegible] in the British navy. Th[illegible] [illegible] delivering b[illegible] [illegible] M[illegible] [illegible] maneuvers off Panama.

The destroyer W[illegible] steamed up to the departing Nelson and hove to. There was a puff of smo[illegible] a gun aboard the Nelson and a line shot across the W[illegible] bow. Sailors on the deck seized the line and attached mail bags, which were quickly hauled aboard the warship.



The line shot from one ship to the other is here being made fast so the mail bags can be pulled aboard.

G. W. Cornelius, aircraft engineer, is [illegible]ing on the edge of the cockpit of his recently tested "free-winged" plane.

TOSS BOTTLES INTO SEA IN STUDY OF WINDS

Almost 500 bottles are thrown overboard daily from British ships into the oceans of the world and allowed to drift where they will. They are not empty, for each contains a set of printed instructions besides a record of the point at which it was dropped. Any one finding such a bottle is asked to send the record taken from it to the Air Ministry in London, first making a note of where it was picked up. Meteorologists hope, by a study of the information thus received, to add to their knowledge of ocean currents and prevailing winds.

Daring Cameraman Snaps Animals on Desolate Isle

Clinging perilously to the edge of an overhanging cliff washed by the Pacific, Lee Passmore of [illegible]

Unfriendly rattlers added a terrifying hazard to Passmore's task. Above is a picture of the largest of seven that he killed while at work. How they reached the islands is a natural history mystery

At right is another view of [illegible]

[illegible]

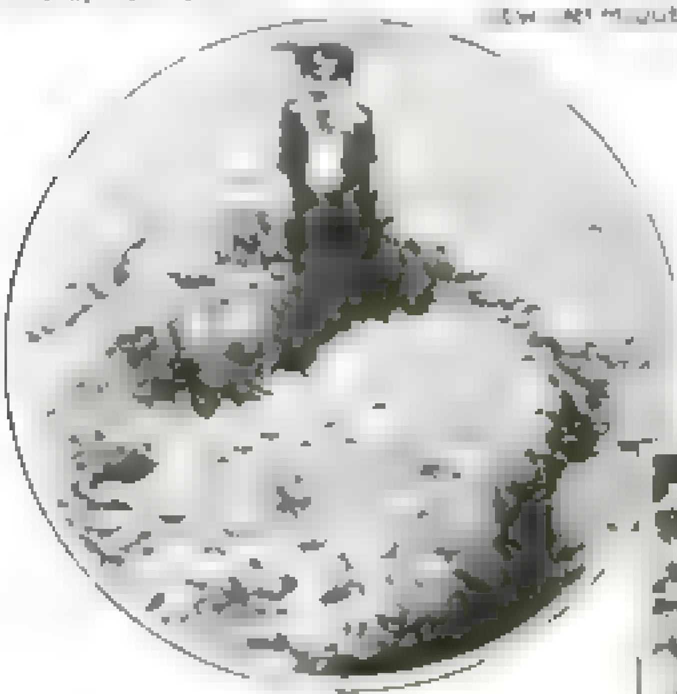
Catching a [illegible]

A [illegible]

Map Earthquakes to Save Roads

[illegible]

[illegible]



Above, one of the nine-inch theodolites that [illegible] earthquake line in California. At [illegible] giant redwood trees which made it [illegible] for the engineers to leave the ground in making their survey

By TOM WHITE

W[illegible]

[illegible] other parts of the United States.

In the first of these three surveys, the engineers went to the known trouble lines. These are "faults" or cracks in the rock layers, along (Continued on page

NEW X-RAY MACHINE SHOWS OBJECT'S DEPTH

Now a doctor may see a patient's internal organs in relief, unlike the flat view given by an ordinary X-ray machine.

A "three-dimensional" X-ray outfit that accomplishes this surprising result is the recent invention of Dr. Jesse William DuMond and Archer Hoyt, of the California Institute of Technology, located at Pasadena.

Through its use, a physician can [illegible] the thickness as well as the area of [illegible] ject, thus getting information [illegible] arly important [illegible] taken [illegible]

Demonstrating the new X-ray machine developed in California with which physicians are able to get photos that show not only the location of objects within the body but also present them in relief as seen in the picture of a hand at top

or locating the lodging place of a bullet in a wounded man.

Two X-ray tubes are placed behind the patient. They flash on alternately. A physician looks at the patient's image, projected on the conventional viewing screen, with his eyes pressed against a special eyepiece. Within it a revolving shutter opens an aperture first before his left eye, then his right, exactly in step with the alternating flashes of the X ray tubes.

Thus the doctor can actually peer around a patient's internal organs, viewing them first from one side and then from the other. The rapid succession of views gives the impression of relief and enables the physician to gage more accurately than ever before both the location of the object or growth and its actual size.

MOTORIZED WORKSHOP FITS IN CLOSET

At left the motorized [illegible]

Above is a good view of the compact chest into which the tools of the motorized workshop fi[illegible]

Few are the homes without enough space for a home workshop [illegible] a clothes closet.

Completely motorized, its eight power tools perform practically any task that the householder desires. It [illegible] a basement, attic, a corner of the kitchen, or even within a tiny apartment [illegible] ing the housewife cause for complaint.

The pivoted sides of the steel-and-wood [illegible] swing outward and upward to transform it into a work table. If desired, the elec[illegible] motor and tools may [illegible] carried, on detachable panels, to the point of the work and clamped to a [illegible] able or perhaps a pair of sawhorses.

All machines and motor conveniently fit inside a neat chest hidden from sight and dust, yet each is available for use in about forty seconds. The top of the tool chest can be used as an entirely satisfactory workbench.

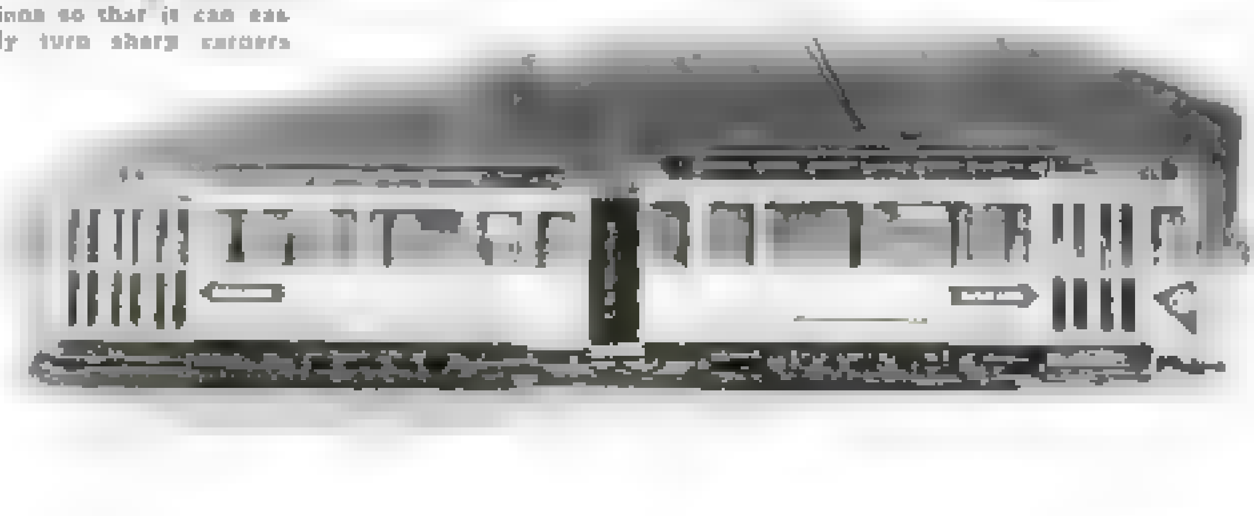
GERMAN STREET CAR CUT IN TWO

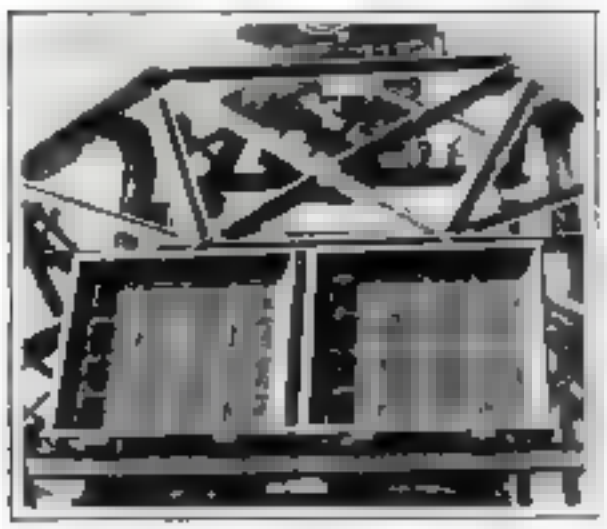
[illegible] lotstrain" street [illegible] been developed by [illegible] engineers as a means of providing additional comfort to riders and greater ease of operation on sharp curves. The new trolleys are really two cars, joined together by an accordionlike device between them, much like the connections between cars of a vestibuled American railway train. One section of the German street car is a smoker.

A bow-shaped trolley pole sliding under the wire, instead of the little wheel with which American cars are fitted, makes the handling of these vehicles easier for their crews. In passing around sharp curves there is no danger of the trolley pole jumping off the wire, for the bow simply slides across it, maintaining contact with it at all times.

Electric window wipers clear the pane of rain and sleet to permit occupants a clear view. Other novelties in the new street cars are individual steel chairs, an electric stop light to warn approaching motorists, and a horn.

This new German street car [illegible] tions so that it can easily turn sharp corners





LOUDSPEAKERS TO HELP MOOR HUGE AIRSHIP

WHEN the naval airship *Los Angeles* drones in for a landing at the Lakehurst N. J., air station, her commander's voice now personally directs the ground crew who moor the giant ship.

Recently six huge loudspeakers were added to the mobile mooring mast that tows the big airship into her hangar. They broadcast the instructions spoken into a short-wave radio transmitter by the airship's captain aboard the dirigible.

BLINDFOLDS GOLFER TO TEACH SWING

PRACTICAL experiments at the University of Illinois prove that the best way for beginners to learn the golf swing is by the use of blindfolds. Dr. Coleman R. Griffith taught two groups, one by the "blinders" method and the other by the "keep your eye on the ball" system.

The blindfolded players, although more clumsy and awkward at first, easily excelled when the bandfolds were removed after one month of practice. Dr. Griffith says that the use of the "eye bandages" causes the player to relax and learn the proper feel of the swing.

Blindfolded golfer is taught correct swing without keeping his eye fixed on the ball.

DEEPEST OIL NOW NEAR THE TWO-MILE LIMIT

DEEPER and deeper into the earth's crust are poking the drills with which men bore for oil.

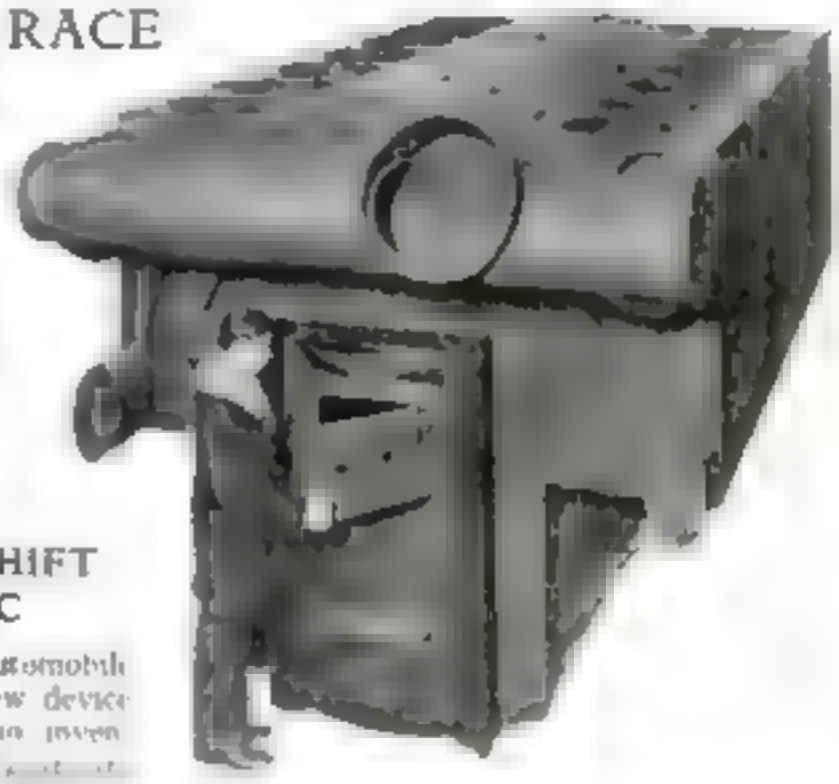
Nearly two miles deep, or 9,700 feet, is the world's record reached not long ago by a well in a California oil field, fifty miles northwest of Bakersfield. Its drillers plan to continue the deep shaft at least as far as the 10,000-foot level. Still greater depths are forecast for the future, with modern technique and machinery.

DIESEL-POWERED AUTO READY TO RACE

THE world's first Diesel racing car recently sped over the sands of Daytona Beach, Fla. It attained a speed of more than 100 miles an hour. So promising was its performance that its designer, C. L. Cummins, of Columbus, Ind., pioneer builder of Diesel automobiles (P S M May '30, p.52), has announced he will enter it in the famous 500-mile race to be held at Indianapolis, Ind., on Memorial Day.

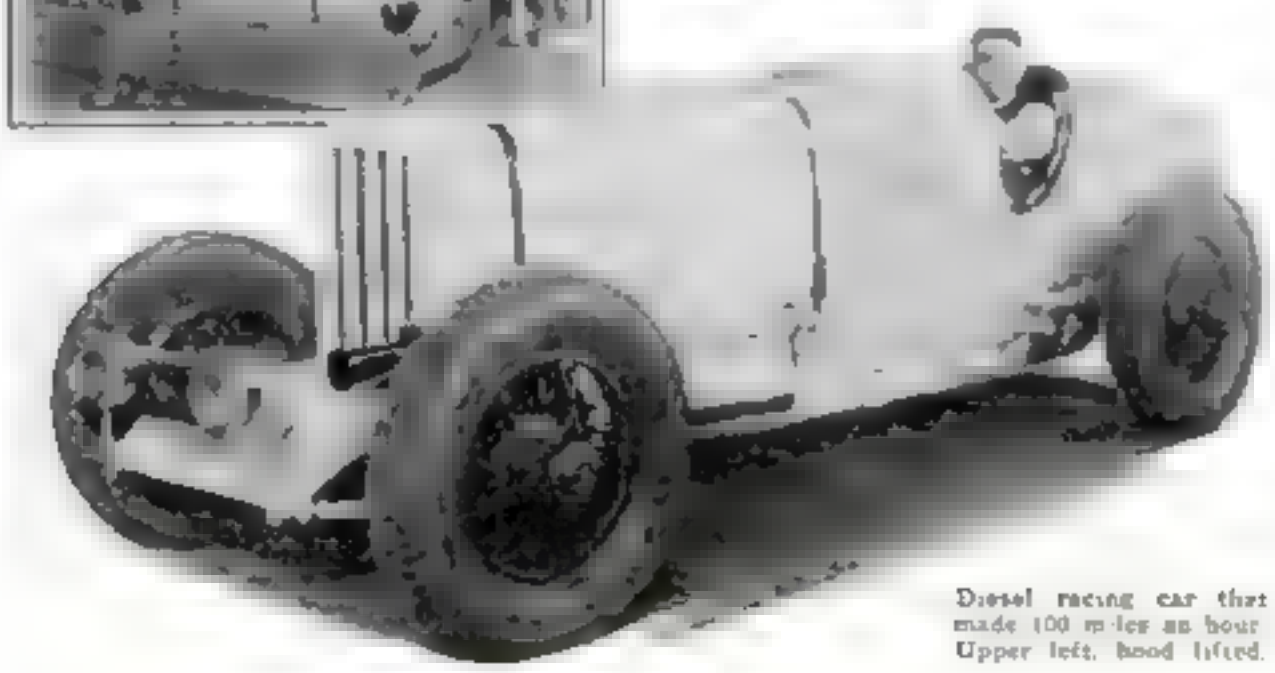
The unique car burns crude oil instead of gasoline. It has no ignition system or spark plugs. The heat of compression is sufficient to ignite the fuel. At a speed of 100 miles an hour, it can travel twenty-five miles to the gallon of fuel, and forty miles to the gallon under ordinary driving speed.

The Diesel-powered racer will run nonstop for 1,200 miles upon a single tankful of oil. This is expected to give it the equivalent of a five-mile start on the whole field of cars at the Indianapolis race, since they will have to stop to refuel.



NEW CAR GEAR SHIFT IS AUTOMATIC

AUTOMATIC shifting of automobile gears is the purpose of a new device designed by a Cincinnati, Ohio, inventor.



Diesel racing car that made 100 miles an hour. Upper left, hood lifted.

ARC-WELDED FURNACE BIGGEST EVER MADE

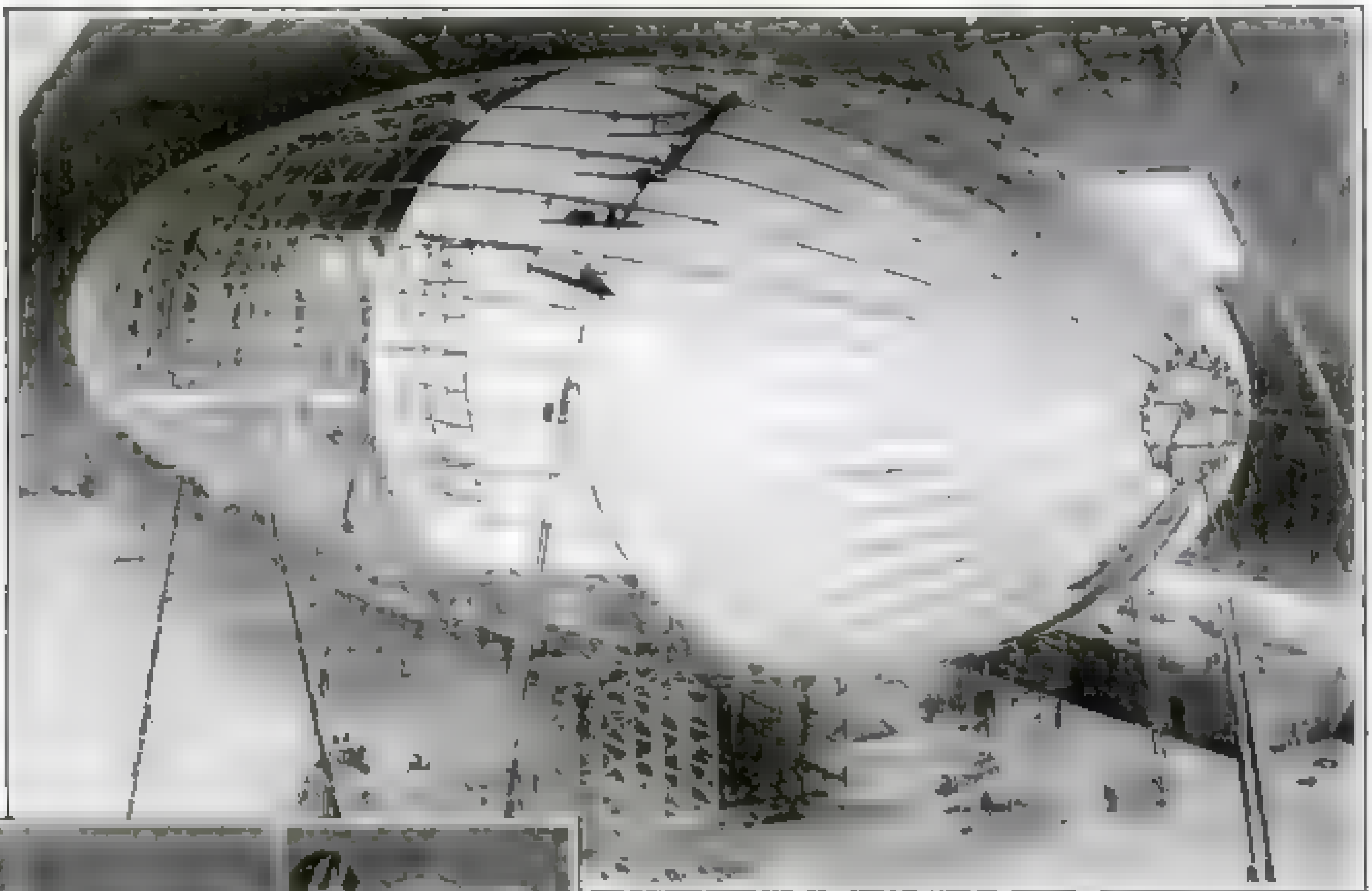
TEN thousand pounds of metal went into what is said to be the largest warm-air furnace in the world, just completed for a large church in Rochester, Minn.

An interesting feature of its construction was the use of electric welding as a substitute for riveting. More than 482 feet of its jointed surfaces were arc-welded through a process developed by the Lincoln Electric and Manufacturing Company, using a shielded arc.

FISH SHOOTS ITS PREY

THE story of a fish that "shoots" its prey was brought from Siam recently by Dr. Hugh M. Smith, scientific adviser on fisheries to the Siamese government. If an insect or spider is perched on overhanging brush or tree roots near the water, the shooting fish knocks it over with a squirt of water.

Akron, World's Greatest Airship, Gets Outer Covering



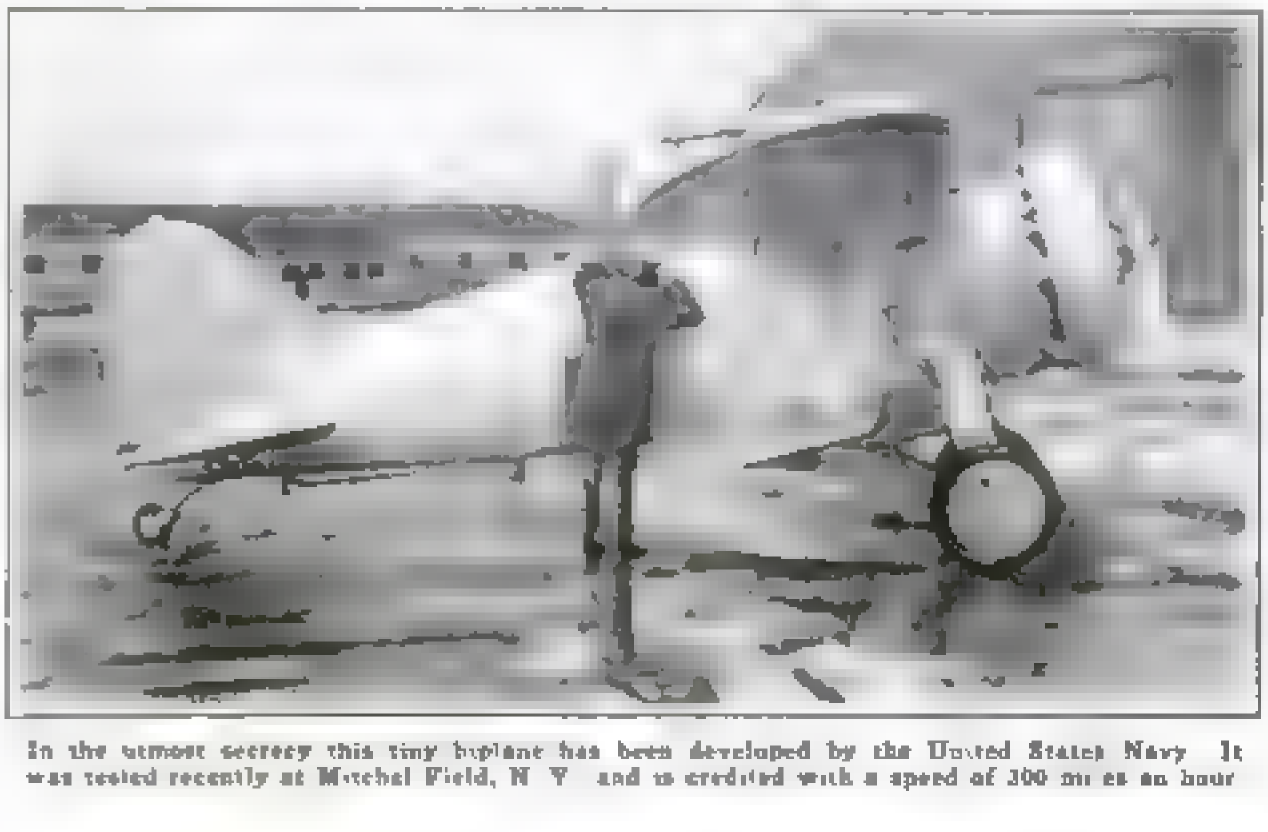
[illegible]

NAVY TESTS MYSTERY PLANE

[illegible] ...ighting ... world. ... the ... Mitchel ... [illegible] to attain an altitude of 29,000 feet. Sleek, trim and streamlined, the Navy gray ship, with bright yellow wings, resembles early Schneider Cup racers. Two machine guns are mounted so that they fire through the propeller. The plane's special motor develops 400 horsepower. The plane's single cockpit is directly back of and above the top wing. The wings are staggered and the fuselage, highly streamlined, tapers to a V shape on the bottom, helping it slip through the air.

Now receiving her glistening "overcoat" of shiny fabric, the Navy's newest and greatest airship *Akron* is nearing completion in her dock at Akron, Ohio. Workmen are rushing the work so that her maiden flight, it is announced, will take place early in June. At her helm will be Lieut. Commander Charles E. Rosendahl, whose name is familiar to readers of this magazine. For years he commanded the *Los Angeles*, and he has told before in POPULAR SCIENCE MONTHLY of his thrilling moments in running that air leviathan. The *Akron* has a capacity of 6,500,000 cubic feet of helium gas, three times that of the *Los Angeles*.

Since the *Akron* will be a military craft, it will carry guns and bomb-dropping equipment. Two "spy baskets" carrying an observer apiece can be dangled through the clouds on 1,000-foot lines while the airship remains hidden in a cloud bank. The *Akron* will also carry a fleet of scouting airplanes.



In the utmost secrecy this tiny biplane has been developed by the United States Navy. It was tested recently at Mitchel Field, N. Y., and is credited with a speed of 300 miles an hour

FLYERS TEST SKILL BURSTING BALLOONS

[illegible]

[illegible]

[illegible]

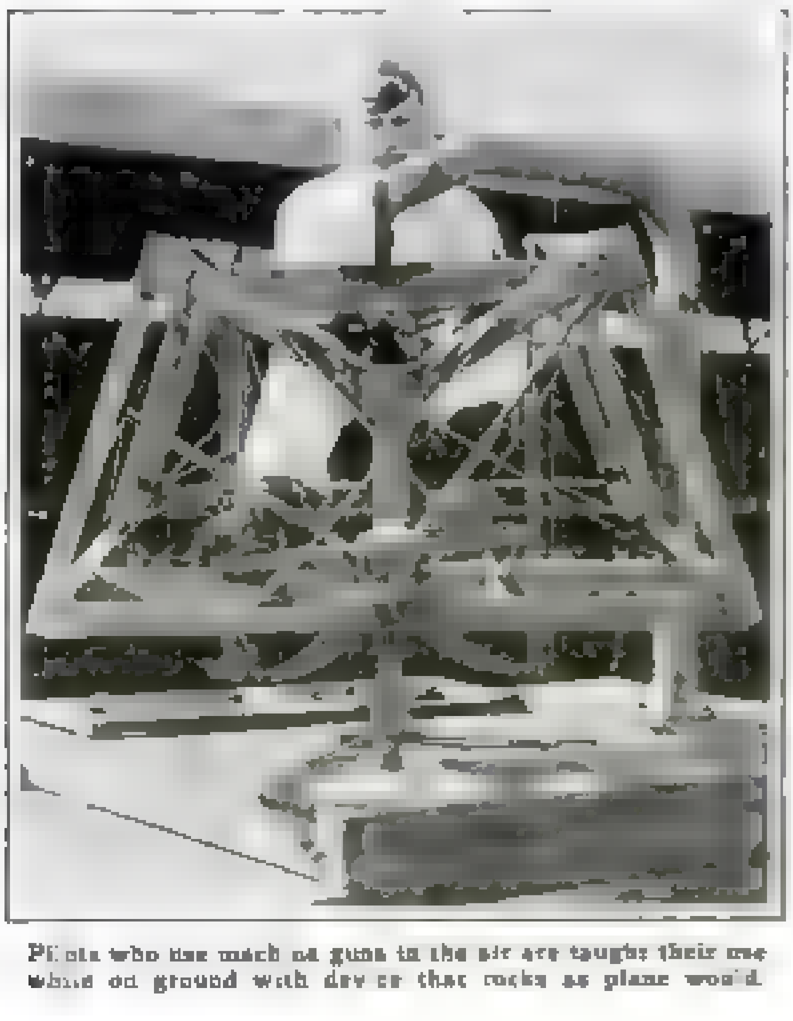
AIR GIVES PLANE ITS HARDEST BUMPS

[illegible] in the air than when it is landing. That was one of the surprising [illegible] recently discovered when Westinghouse engineers fitted a plane at the Newark Airport, N. J., with a new electric [illegible]. Heretofore such shocks [illegible]

[illegible] electric [illegible] in the cockpit of the ship. [illegible] wires run to wings, struts and [illegible]. They end in electric [illegible] the size of a cake of soap. [illegible] press the contact points together register on the central box in hundreds of pounds stress.

Shocks on the wings from "bumpy air" were registered as high as 18,000 pounds, while a sixty-mile-an-hour landing registered a shock of only 16,400 pounds.

TRAIN PILOTS TO SHOOT ON GROUND



Pilots who use machine guns in the air are taught their use while on ground with device that rocks as plane would.

PRACTICE of aerial machine gun fire on the ground is made possible by a device which has been installed at a Texas flying field.

The ground device, used in training airmen, is a wooden framed cockpit with a machine gun fitted to it. The frame is pivoted in such a manner that it will turn or nose down or up like a flying plane so the pilot may train his gun on the target.

NAVY PLANS BIG METAL AIRSHIP

BIGGER than the giant airship *Los Angeles* will be an all-metal dirigible for the U. S. Navy on which work is expected to start shortly. It is to be patterned after the much smaller metal-clad blimp built for the Navy some time ago by a Detroit aircraft company, which has proved itself in numerous cruises.

Here is the central recording box of the electric device that measures strain on plane.

DRAGON FLY PLANE MEETS TEST

AN odd looking little plane is the one recently perfected by Earl E. McClary, aeronautical engineer, of Huntington Park, Calif. It is a cabin monoplane with fuselage cut away in unusual fashion in order to give the pusher propeller room to turn. Those who saw the new plane on its trial flights said this gave it the appearance of a large dragon fly. McClary planned a craft that would handle more easily than ordinary planes and give pilot and passengers greater comfort while flying. Its unusual shape can be seen in the photograph.

Trials of his new ship showed that he had succeeded in obtaining some of these qualities. The plane took off at speeds of between twenty-five and thirty miles an hour. Both pilot and passengers, riding in the cabin ahead of and below the wing, found themselves protected from the noise of the engine. This position also gave them a clear view ahead and to the right and left of the plane.

TINY AIRPLANE HAS NO TAIL FLAPS

A TINY airplane which needs no elevators, or tail to control ascent and descent, was flown recently in Tollerton, England. The ship, which is a high-winged single-seated monoplane, has wings of an unusual design. The after edge of its wing tips extend back beyond the center of the wing, forming a shallow "V" in a horizontal plane. The front edge of the wing is also built V-shaped, but the angle there is much sharper than on the wing's after edge.

PUSHER PLANE USES LITTLE FUEL

ONCE more builders are turning to the "pusher" type of airplane in which the propeller is mounted at the rear of the wing, reviving early styles in aviation. A little two-place monoplane recently designed by Hammondsport, New York, airplane builders is driven by a forty-horsepower motor turning a pusher propeller.

Carrying one passenger the new ship can take off after a run of six seconds. It lands at a speed of twenty-eight miles an hour. The makers landed in and took off from a five-acre ploughed field, demonstrating its suitability for private use.

Eight gallons of gasoline give it a cruising range of about 200 miles. Its cruising speed is seventy and its top speed eighty miles an hour, it is claimed.

This light pusher plane will seat one passenger and has a cruising range of 200 miles on eight gallons of gasoline.

No elevators or tail flaps are used on this little plane to control descent or ascent. It is a single-seated monoplane that has wings of a most unusual design.

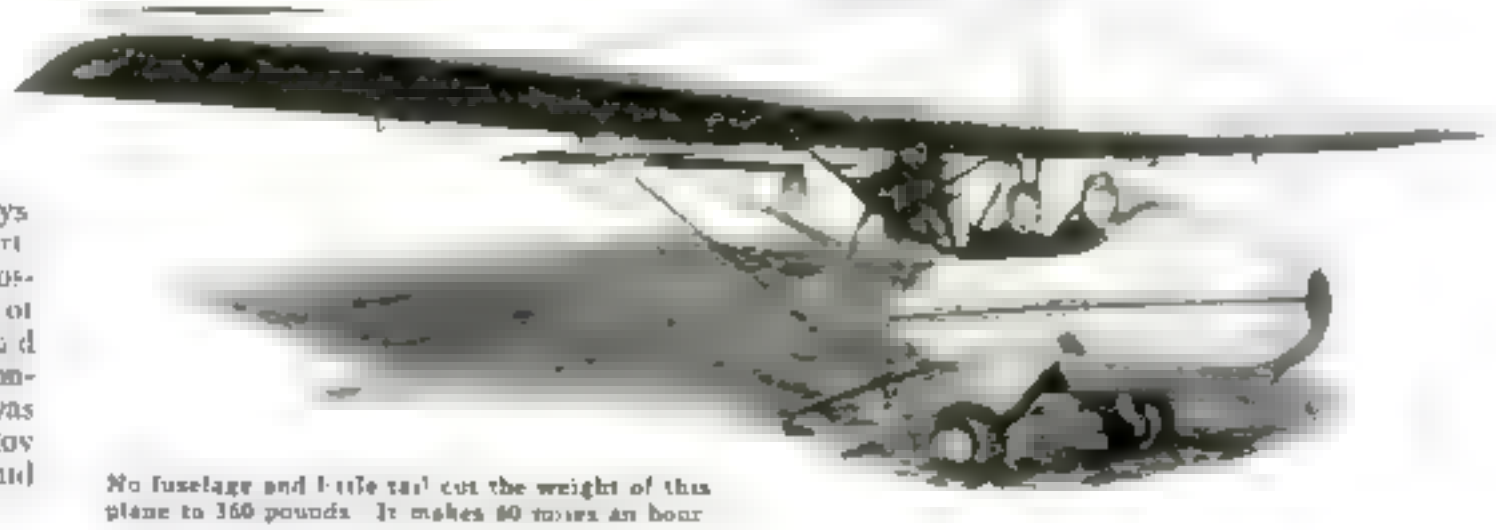
UNUSUAL SPORT PLANE HAS NO FUSELAGE

PILOT and passenger ride in a car shaped like a Zeppelin gondola beneath the wings of a novel sport plane tried out the other day at Lincoln, Nebr. Devoid of fuselage and with only the suggestion of a tail, the strange craft is an innovation among light airplanes. It weighs only 360 pounds.

A twenty-five-horsepower motor gives the plane a top speed of eighty miles an hour. A single gallon of gasoline, according to the designers, will keep it in the air for an hour. It is made as a "flyver" plane for persons of moderate means.

AUTOGIRO TO AID COPS

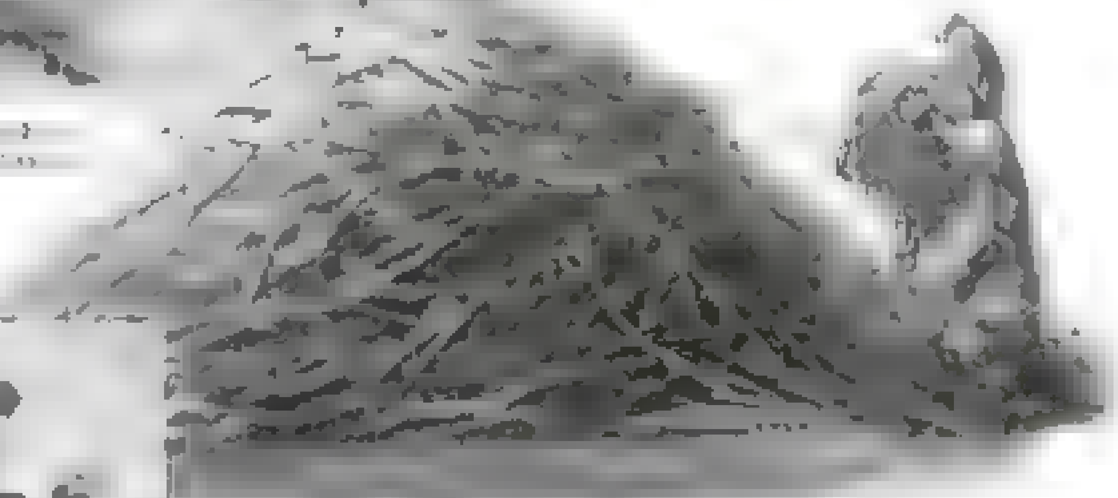
AUTOGIRO police may be an actuality in New York City, one of these days. The New York Police Department is investigating the possibilities of this aerial type of "windmill plane" which could land in city parks within congested areas. New York was one of the first cities to employ conventional planes as an aid in its police work.



No fuselage and little tail cut the weight of this plane to 360 pounds. It makes 80 miles an hour.

Weather Ignores the Groundhog

[illegible]



A[illegible] a curious bit of weather lore. He checked up on the per[illegible]ance of the groundhog [illegible]

[illegible] February [illegible] tradition has [illegible]

[illegible] But if the groundhog spies his shadow, meaning that the day is sunny, he scuttles back into his hole and we are in for six weeks more of winter.

Of course he may refuse to come out at all. That is one of the hazards that groundhog observers must face. But usually, somewhere in the United States, an obliging groundhog is to be found who will [illegible] appointed time and pose for [illegible] weather prophets.

NOW let us look at his Chicago record, revealed by Donnel's figures. The [illegible]

[illegible]

A[illegible]

[illegible] remarkable ability of plant and animal weather prophets. The average American remembers a few from [illegible]hood. Immigration has brought others to our shores. If a dog eats grass, is that not a sign of rain? Are not corn husks unusually thick before a severe winter? And how about the

[illegible]

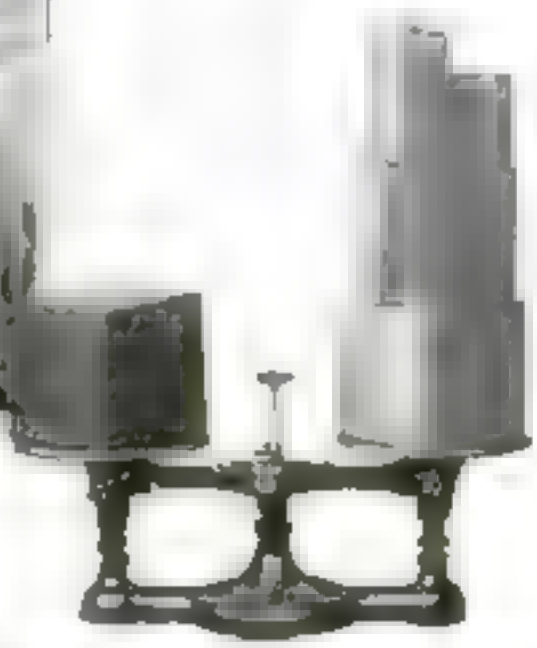
A[illegible] wea[illegible] with [illegible]

As [illegible] farmers husk corn they say the w[illegible] husks are thick. At right the hor[illegible] a ha[illegible] wing[illegible] is due to visit the[illegible] locality

Balsa, Nature's Miracle Wood, Finds Amazing Uses

Lighter Than Cork, Ecuador's Strange Product Makes Fine Life Preservers and Insulates Against Noise and Heat

By CLAYTON R. SLAWTER



Lighter than cork! Note that the block of cork on the left outweighs the balsa pile on right

In spite of its light weight, balsa wood has a strength almost half that of good spruce. It is easily worked, cutting like butter under a knife. Its consistency is something like rubber, for a piece of this astonishing wood can be compressed to nearly half its original volume between the fingers.

ENGINEERS of a big silk manufacturing firm in New York were faced recently with a difficult problem. Vibrations caused by heavy machinery in their plant on the twenty-third floor of a skyscraper ran down the building's steel framework and were felt on every floor. Other tenants complained. Wood and rubber mats placed under the machines failed to deaden the vibrations. Complaints continued to pour in with every mail.

Some one thought of balsa wood, the only material they had not tried. A telephone call brought samples from an importer. Next day the importer received another phone call from the silk people. "Send over more balsa as soon as you can! The samples you left yesterday have done wonders. Hurry up the rest of it!"

On the following day large slabs of balsa wood were installed under the machinery. Vibrations and complaints both ceased. Where wood and rubber mats failed balsa wood succeeded. This is but one example of the many uses to which this amazing wood is put.

Balsa, the lightest wood known to man, is found almost anywhere in the tropics. The balsa we see in use however, is grown in Ecuador, the little country on the west coast of South America divided by the mighty ramparts of the Andes Mountains and crossed by the equator. The trees have fairly smooth bark and large broad leaves. They may grow as high as seventy or eighty feet, with trunks from thirty to thirty-six inches in diameter. The wood, half as heavy as cork, weighs only five to seven pounds to the cubic foot.

Examine a piece of balsa wood under a microscope and you will see that its structure resembles that of a honeycomb. It is made of a myriad of tiny cells. These give it buoyancy, lightness, and insulating qualities. In balsa trees more than five years old, the cell walls thicken and the wood grows heavier. For this reason balsa trees over five years of age are never cut for commercial purposes.

IMAGINE a twenty-foot pine timber ten inches square; it will weigh about 325 pounds. A balsa beam of these dimensions, however, will weigh about seventy-five pounds. Carry it down to the water and set it afloat and you will find that it can support almost ten times its own weight, so buoyant is it.

After the trees are cut down in Ecuador they are strung together in rafts as seen above and floated downstream to waiting ships.

WE FIND balsa wood first mentioned by the early Spanish explorers. When Pizzaro invaded Peru, he sent Bartholomew Ruiz, his pilot, along the coast on a foraging expedition in 1526. Rolling along before the light trade wind, the Spaniard doubtless thought himself lord of all those seas. Picture his surprise then, when he saw another sail on the horizon.

Drawing near the stranger, he saw it was a big Indian raft, rigged with square sails and carrying a thatched hut amidships. It was made of tree trunks lashed together with vines.

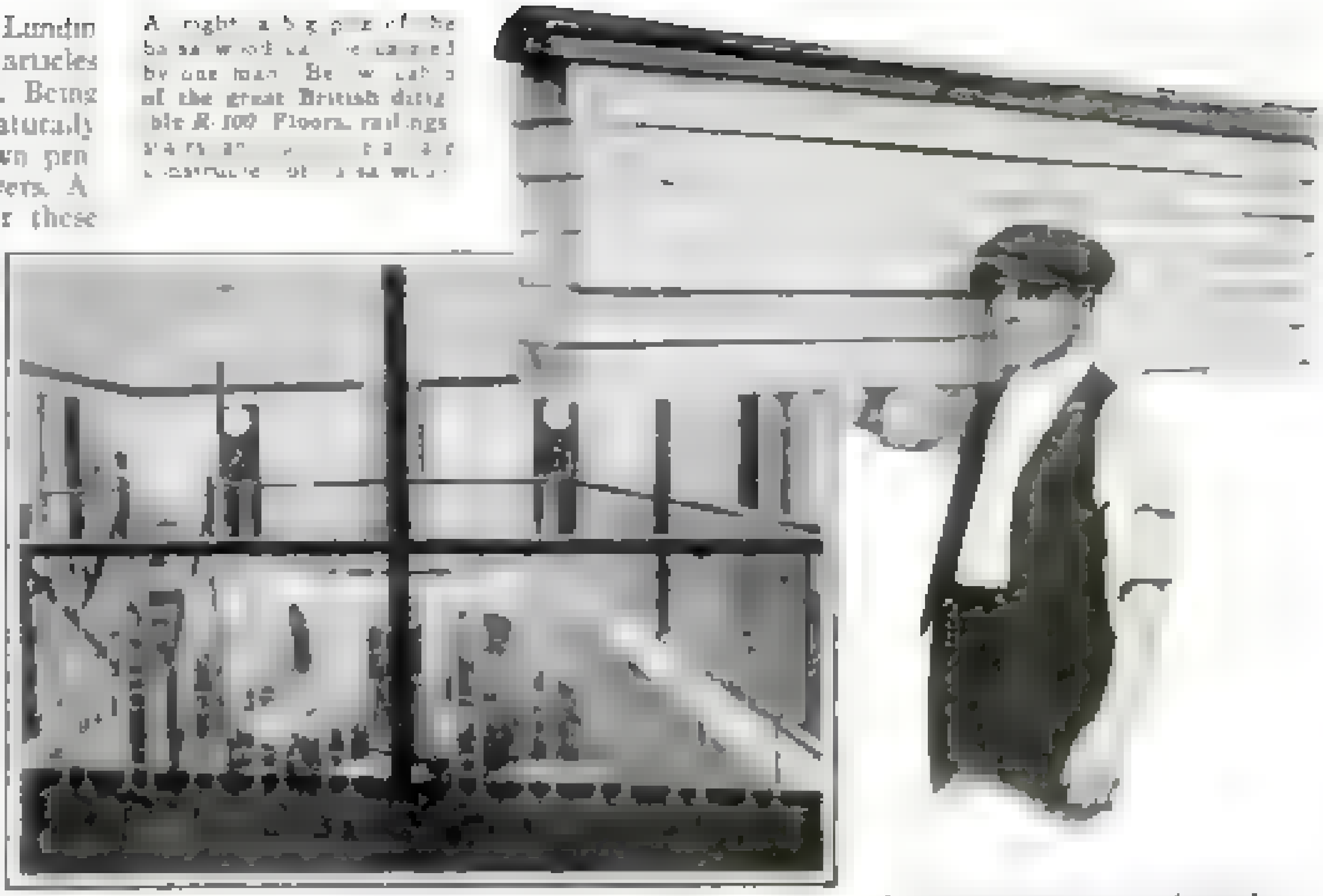
Questioning the natives, Ruiz learned that they called their odd craft a "balsa," after the trees from which it was made. This name has stuck to the trees ever since.

Centuries passed and balsa wood remained unnoticed by white men, although the Indians continued to use it. Finally, in 1911, Captain Lundin, an American seaman, went to Central America on a trading voyage. He anchored his schooner in a small bay off the regular trade routes, where few steamers and no tourists ever came. With Captain Lundin was his daughter.

So excited were the natives at the visit of a white girl that they staged a fiesta for her. There were dances and feats of strength before the huge feast which marked the climax of the celebration. Just before the feast a chief walked into the clearing where the fiesta was held carrying a whole tree on his back! It was a balsa tree, the first Captain Lundin had ever seen cut down.

THE shrewd Yankee captain saw possibilities in this strange wood and began to collect a cargo of it. In this way balsa wood was first brought into the United States.

When he arrived home, Captain Lundin formed a company to manufacture articles from the wood he had rediscovered. Being a seafaring man his ideas turned naturally to products connected with his own profession—life rafts and life preservers. At first there was a limited field for these articles, for balsa wood was then very expensive, selling for $250 a thousand board feet.



A [illegible] big pile of the balsa wood can [illegible] carried by one man. Below, cabin of the great British dirigible R-100. Floors, railings [illegible] constructed of balsa wood.

THEN the tumult and havoc of war shattered the peace of this country and the balsa business began to expand rapidly. The featherweight wood was a necessary war material, and huge quantities of it were used regardless of price.

A familiar sight in our big seaports almost any day during 1917 and 1918 were the huge transports. They slipped out to sea, usually under cover of the gathering darkness. Their decks swarmed with khaki-clad men, reënforcements for the hard-pressed Allied lines in France. As such they were almost priceless, and every effort was made to safeguard them on the long ocean journey.

Balsa rafts were installed in place of lifeboats. Enough of these to support 450 men could be stowed in the space formerly occupied by one lifeboat, which could carry only thirty or forty men.

Many of the men in those troop ships later became used to the sight of trains of figures, slogging through the mud of France and Flanders in the dead of night. Mules, horses, men, and wagons carrying supplies to the fighting men huddled in their trenches in the darkness.

The work of keeping the front line supplied with necessities was hard, but balsa was lightening it. Whenever perishable supplies were taken up to the line they were packed in water-tight balsa wood cases. These could be dropped into flooded shell holes without injury to their contents, and their lightness made them easy to transport.

The scene shifts to the North Sea. Odd-looking vessels rolling and plunging in the gray swells appear and disappear in the mists like phantom craft. You notice that their decks resemble small railway yards. They are covered by narrow-gage tracks on which seamen push hand cars loaded with big metal globes. These are trundled to large openings in the vessels' sterns and dropped overboard every few seconds. The strange-looking ships are laying the eggs of death—submarine mines.

HERE again we find balsa wood used. Exploding gear for mines is so expensive that naval officers try to salvage it after the mine goes off. Cork floats were tried, but they were always destroyed by [illegible]

from steaming tropical jungles to the cold north, where death stalked on land and sea, to do its work like a marine—afloat and ashore.

AFTER the Armistice, war materials, like discharged soldiers, began to seek jobs in peace-time industries. Among these balsa was given a bigger and more varied position than it held before the war. Airplanes began to be used for carrying passengers. Big cabin ships, luxuriously furnished, were fitted with every convenience known to passenger transportation. Almost from the first, balsa wood was used for finishing the interiors of these planes, its light weight making it the ideal material for the purpose.

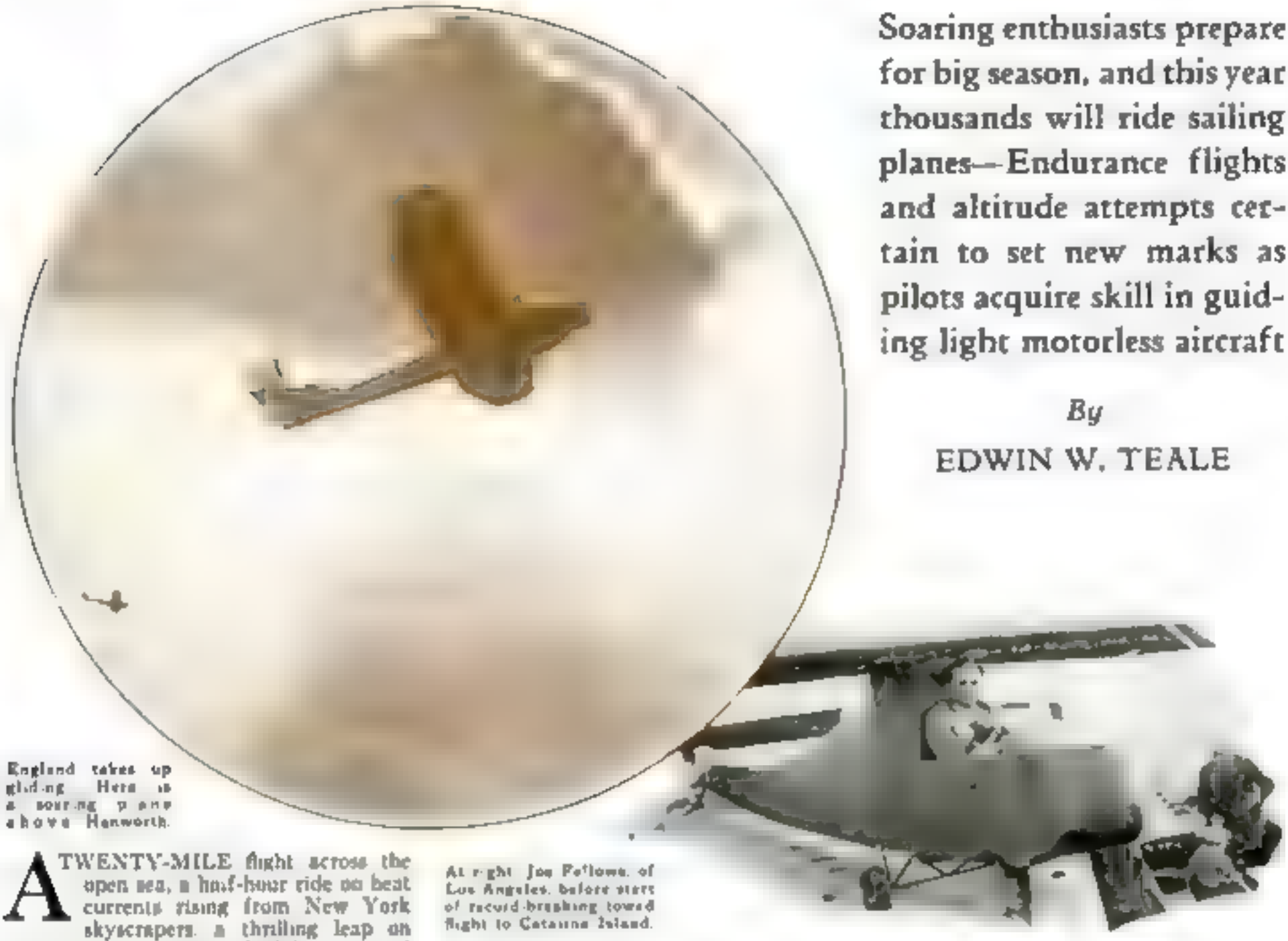
Today airplane builders use balsa for paneling, bulkheads, and furniture in most passenger planes. One of the largest multi-engined ships in the country uses balsa to such an extent that every part of the ship not made of metal is made of this light wood. Balsa is also employed to add to the efficiency of airplanes as well as to furnish comfortable surroundings for their passengers. [illegible]

At left, Jesse W. Reno, New York inventor, with his balsa wood gun designed to shoot a life saving raft to swimmers. Above, the raft after being shot to bathers all of whom cling to it.

New Glider Records Come Fast

Soaring enthusiasts prepare for big season, and this year thousands will ride sailing planes—Endurance flights and altitude attempts certain to set new marks as pilots acquire skill in guiding light motorless aircraft

By
EDWIN W. TEALE



England takes up gliding. Here is a soaring plane above Hanworth.

At right, Joe Fellows, of Los Angeles, before start of record-breaking towed flight to Catalina Island.

A TWENTY-MILE flight across the open sea, a half-hour ride on heat currents rising from New York skyscrapers, a thrilling leap on skis with a wing-clipped glider strapped to the jumper's waist, a swoop across the San Fernando Valley from a California mountain peak, and the trial of a weird rubber monoplane inflated with air have been the high lights of recent glider activity.

With the coming of spring glider clubs from coast to coast are getting their motorless machines ready for air-sailing. Today, for every nine airplanes in America there is one glider. The number of enthusiasts engaged in the sport is given by the National Glider Association as nearly 3,000, and the latest figures of the Department of Commerce show the number of motorless planes exceeds 1,100. This includes both gliders—machines that "coast downhill on air" from an elevation—and soaring planes—built to ride aloft for hours on currents of rising air.

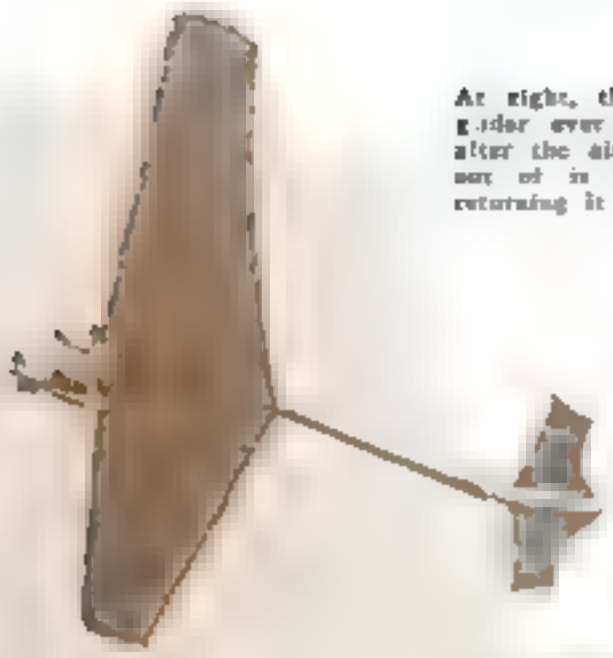
In such a soaring craft, the other day Jack O'Meara, one of America's crack pilots, was towed high over New York City by an airplane to make a thrilling test of a new type of motorless flying. At more than 3,000 feet, he cut loose.

Lifted by the rising warm air streaming upward from the heated buildings of the great city, his light machine soared away. For more than half an hour he cruised about before landing at Glenn Curtiss Airport, Long Island. It is predicted that these warm air up-currents above large cities will provide ample lifting power for long soaring flights in winter months.

Such sky sailing, in which a heavier-than-air machine appears to defy gravity, wheeling aloft for hours at a time and covering hundreds of miles, depends entirely upon up-currents in the atmosphere. When one of these wide-winged, featherweight planes enters a column of air moving upward faster than the machine is moving downward, it leaves the rising column with more altitude than when it entered it.

SOARING ships descend very slowly. The latest craft often drift ahead twenty feet for every one they descend. Thus, the graceful planes can glide across the sky, once they have been launched

Two outdoor sports, skiing and gliding, were joined when Carl Messelt, professional ski jumper, added wings to his skis for a long jump last winter at Duck Hill Falls, Pa.



At right, the first rubber glider ever built is seen after the air has been let out of it preparatory to returning it to the hangar

Above, the rubber glider built in Washington, D. C., and here seen with pilot Joseph Berling at the controls. At upper left, it is shown in the air

from an elevation, from one rising current to another losing a minimum of height.

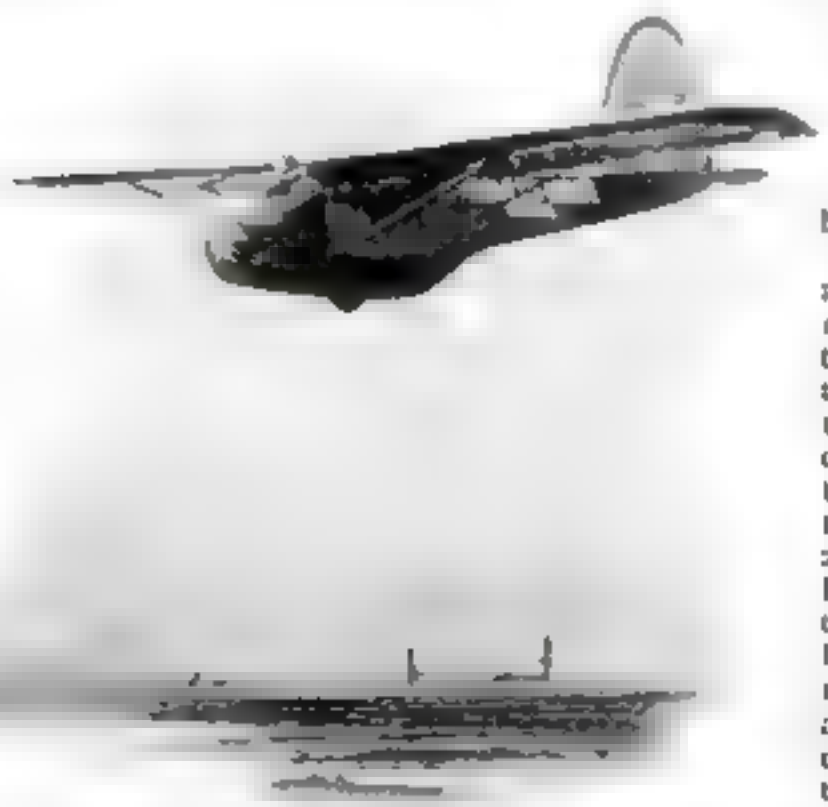
These rising currents are of two types. Thermal ones are usually created by the sun beating down upon bare ground heating it so that it throws off strong rising columns of warm air. The most commonly used up-currents, however, are formed by a wind striking a hillside and being deflected upward.

EVEN slight breezes hitting the side of a long ridge sometimes permits soaring. At Elmira, N. Y., where the first American soaring competition was held last fall, O'Meara guided a graceful "Condor" soarer back and forth along the ridges for an hour and fifteen minutes on a day so still smoke from a bonfire rose almost straight into the sky. The big sailplane moved majestically through the air, so steady that once the pilot stood up in the cockpit to drink from a vacuum bottle and then dipped his plane in salute to the onlookers.

Over these same ridges, on a windy day a week later, Albert Hastings in a Franklin machine and Warren Eaton, in a Baker-McMillan "Cadet," fought a duration duel that carried Hastings to a new official American endurance record of seven hours and forty-three minutes. The fifteen-hour flight made by Jack Harstow in a Bowlus sailplane at Point Loma, Calif., last year was unofficial.

All afternoon the two machines hung close together riding high on the up-currents above the ridges. At sunset the wind began to die down. The ships continued their wheeling flight. Dusk closed in and the moon arose. Like great night birds, the planes could be seen by the spectators momentarily silhouetted against the moon as they coasted silently through the dusk.

Beacon fires were lighted at the Elmira Airport. Finally, the flyers slid down out of the darkness into the red light of the bonfires and landed. Hastings, who drove an automobile from Los Angeles, Calif., in order to enter the meet, had won by twenty-two minutes. He was awarded the Edward S. Evans Cup and a cash prize of $250.



Jack O'Meara landing at North Beach, N. Y., after a twenty-five-mile glide that began 3,500 feet above New York's skyscrapers.

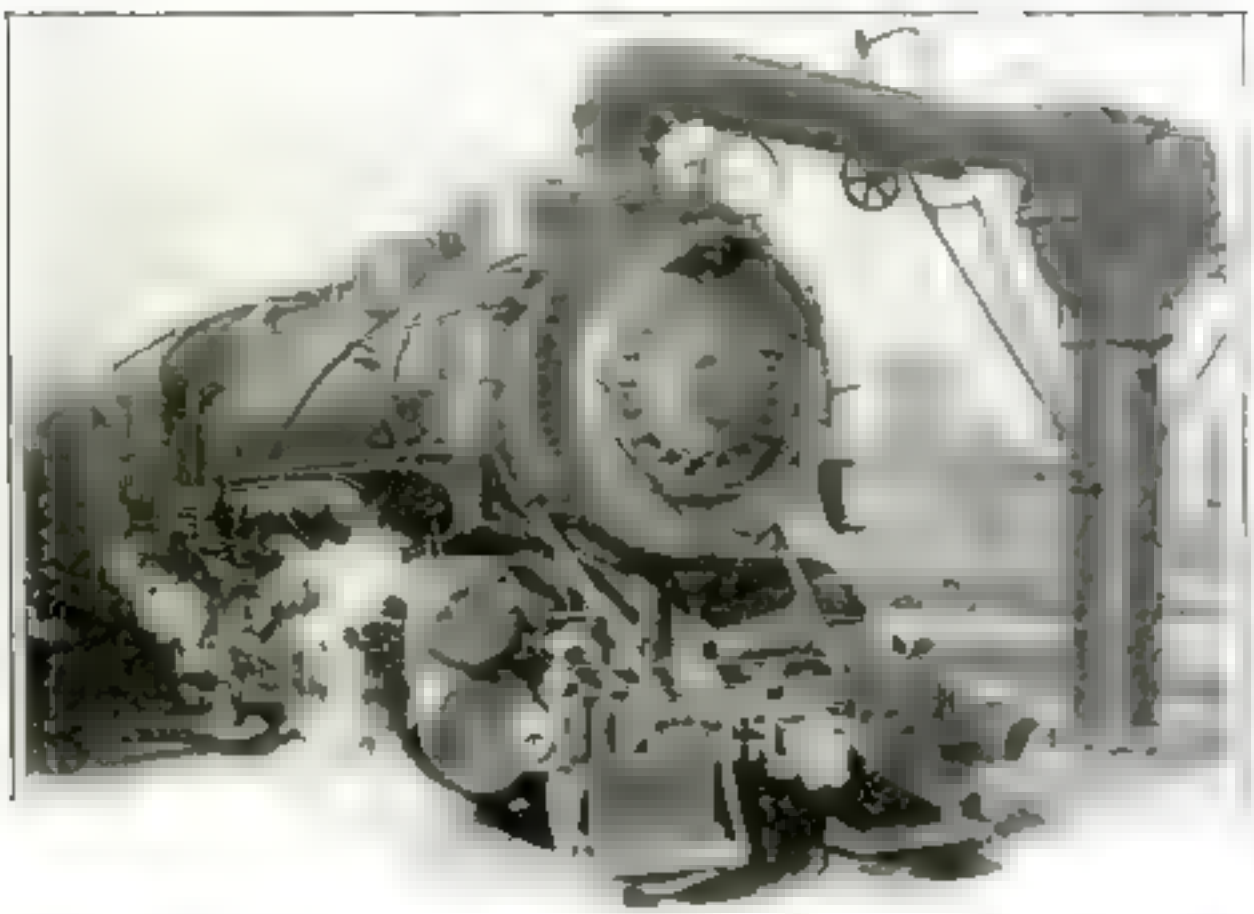
ANOTHER flight of more than seven hours was made by Wolf Hirth, the famous German soaring ace who brought a beautiful plywood "Kegel" to the competition. In this machine he made the largest number of qualified flights, twenty-three. On one, he flew cross-country for thirty-three miles.

A. C. Haller, of Pittsburgh, Pa., at the stick of another "Kegel," covered more than twenty-one miles cross-country before he was forced down. When he found he would have to land, he was above dense woods and broken country. The only open space was the Susquehanna River, winding slowly through the hills.

Skimming low above the water, Haller, at the last moment, headed toward shore. Like a skipping stone, the light craft flitted across the surface of the water and slid up on the sloping bank unharmed. The low landing speed of the machine made the maneuver possible.

It is this ability to come down at slow speeds that makes gliding and soaring relatively safe sports. A glider touches the ground at twenty miles an hour or less; an airplane lands two or three times as fast. In emergencies, glider pilots have landed their light, slow-moving planes among bushes without damaging them.

Learning to fly a glider is a long step toward mastering a motored plane. Such noted pilots as (Continued on page 126)



ENGINE SMOKE IS CAUGHT AND CLEANED

One of the ways that Chicago keeps clean is to prevent locomotives in railroad yards from belching black smoke into the air. At one of its terminals, a specially-constructed hood, like that illustrated above, is swung out over the smokestack of a standing engine while it is getting up steam. Smoke drawn up the stack is not released into the air until it has been scrubbed and cleansed

This novel expedient is one more illustration of the war being waged against smoke in many of America's large cities Strikingly successful efforts to abate the smoke from factory chimneys have already been made. In many cases the installation of high-tension electric "precipitators" has been found to collect the particles of soot before they leave the chimney, and a more recent innovation is a special dome for the chimney top that sprays issuing vapors with water to clean them

NEW MACHINE GUN TOY BLOWS SOAP BUBBLES

Bubbles galore, to delight a child's heart, are the product of a new toy that forms them with the rapidity of a machine gun. Blowing into its pipe shoots a rapid stream of the colorful bubbles into the air The novel plaything is filled with soap solution, made by dissolving a supply of prepared soap in a glass of water

It is started by tipping the nozzle downward, filling the barrel with soap solution from the reservoir and is repeated whenever the bubbles stop. Some skill is required to operate the toy but the knack is said to be speedily acquired.

Bubbles come out like bullets from a machine gun when a child blows the nozzle of this toy

AIR DRIVES FILER AT 5,000 STROKES A MINUTE

Speedy, accurate filing in the shop is now made easier by an entirely new type of hand tool. It works by compressed air and makes as many as 5,000 strokes a minute. A unique "file guide," an eight sided knob keyed to the spindle, turns the file to guide it over an irregular surface at the touch of thumb and forefinger, while the tool is held steady It may also be locked and the file guided with the pistol-grip handle, in the usual way

The illustration shows an operator using the new filer on a die. Lying on the bench are two other new compressed air tools, a tiny chipper and a grinder

AIR, FREED OF NITROGEN, AIDS DIVER

SYNTHETIC air new aid to divers recently received a successful try-out at the Philadelphia Navy Yard, in anticipation of a rescue on Sir Hubert Wilkins submarine trip across the Arctic Ocean. The man-made product proved better than natural air Divers using it escaped any trace of "bends," painful ailment caused by absorbing nitrogen gas from ordinary air into the blood under pressure

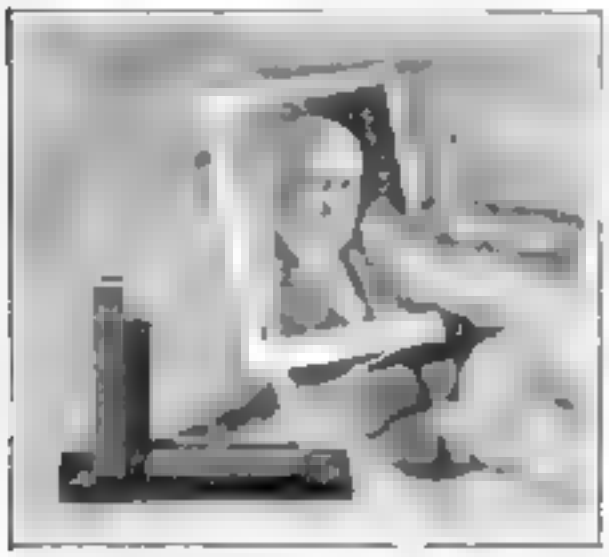
The artificial atmosphere contains helium and oxygen instead of the nitrogen and oxygen of natural air (P S M, Mar [illegible] p 4)

In an effort to prevent "bends" which afflict deep-sea divers when they are raised too rapidly a synthetic air of helium and oxygen has been prepared and, above, is being tested.

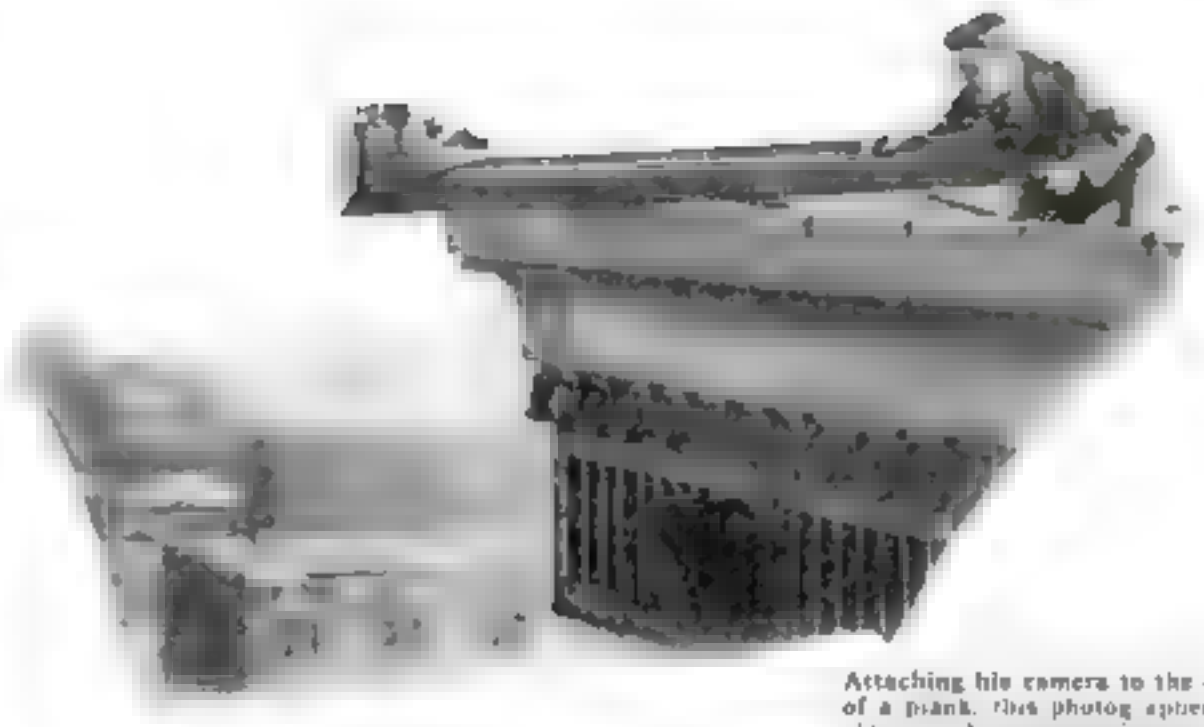
FRAME FOR SNAPSHOTS HAS GLASS AND STAND

Now even the humble snapshot has a picture frame designed especially for it. A favorite snap of mother, father, or sweetheart slips between two panes of beveled glass and stands upright in this ingenious little frame of modernistic design. Two photographs can be inserted, back to back if desired, for the contents can be viewed from either side

The particular advantage of this decorative piece for the bureau top or chiffonier is that no special mounting of the picture is necessary, and the stand is itself decorative and holds the picture securely upright. There is no fitting or pasting to be done, since the picture is simply slipped in or out in a moment



How snapshot photos are framed between plates of glass and held in attractive stand



Attaching his camera to the end of a plank, this photographer is able to take pictures from most unusual positions and angles.

CAMERA ON PLANK GETS RARE PHOTOS

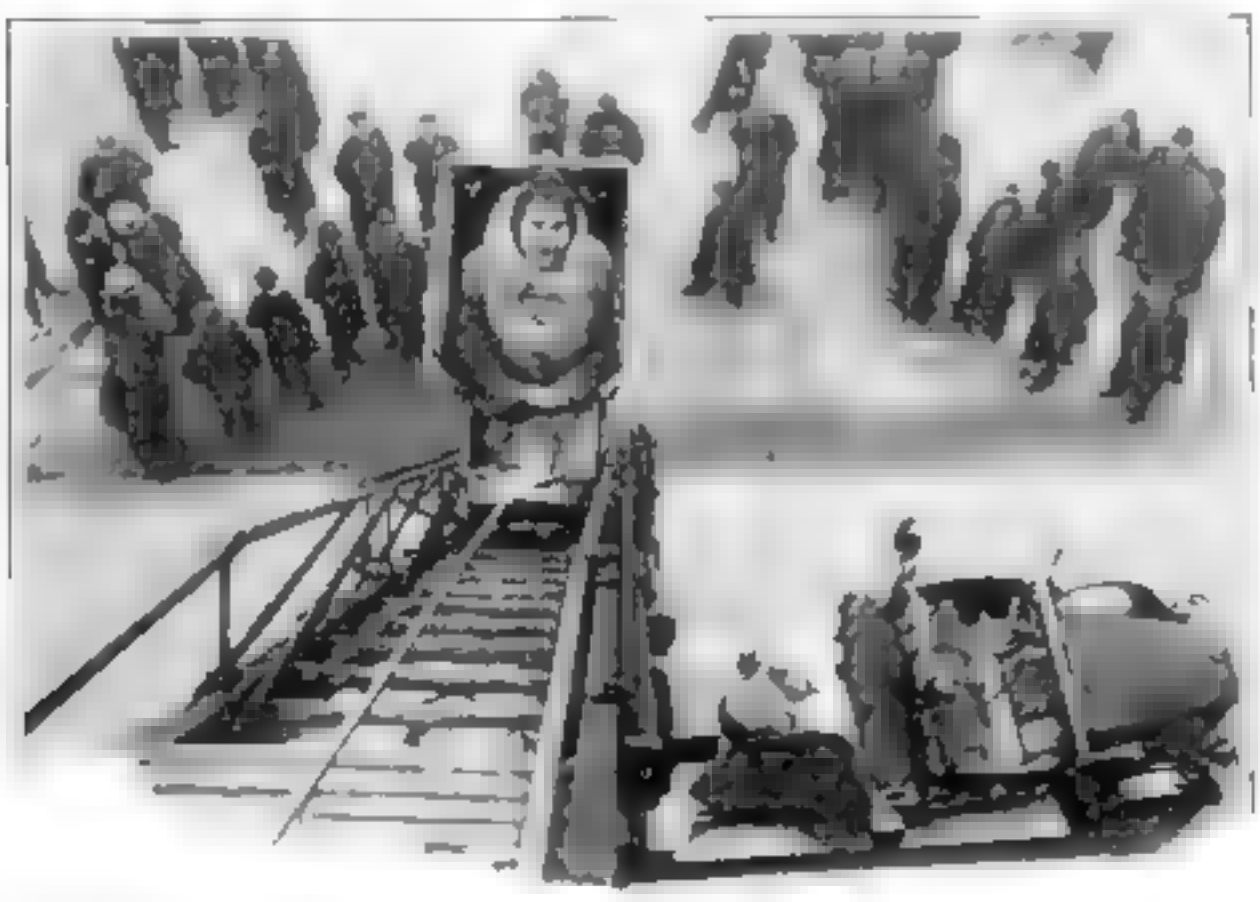
A news photographer of Omaha, Nebr., invented a "sky hook" for a camera the other day as an aid in taking shots from difficult angles

His camera is mounted at one end of a light plank about eight feet long. A movable wooden rod extends from it to the end of the plank. This works the shutter of the camera when the photographer is ready to snap pictures

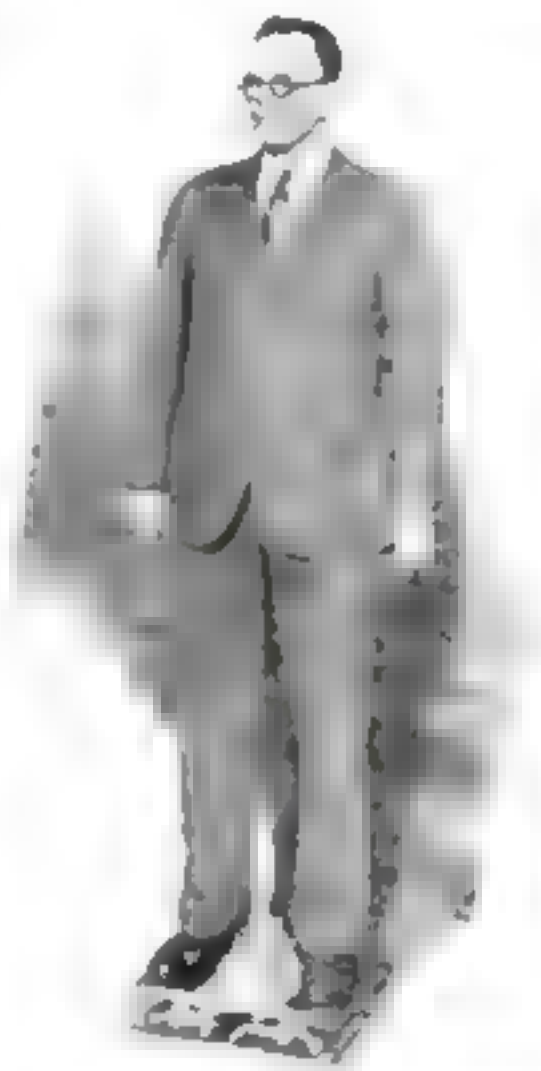
By using this device he has obtained views looking directly downward from the roofs of buildings and made pictures of parades and other public events over the heads of spectators, or from windows.

RESCUE BASKET SAVES FIRE VICTIMS

"Up and down a ladder runs a novel rescue basket" demonstrated the other day by German firemen. Suggesting the "baker's chair" used to lower persons over the side of ships, it makes easy the task of saving invalids from a burning building. The escaping person is helped into the basket at the window's level and lowered by a rope to the ground. A special ladder equipped with the new chair was recently added to the apparatus of the Berlin fire department. The apparatus of course adds a factor of safety to the escape of the healthy as well as the infirm, since many persons are so affected by altitude that climbing down a straight ladder, even to save their lives, is practically impossible for them



Looking down from a high window while a young woman is lowered in a new rescue basket developed by the firemen of Berlin, Germany, to aid in saving lives of invalids trapped by a fire

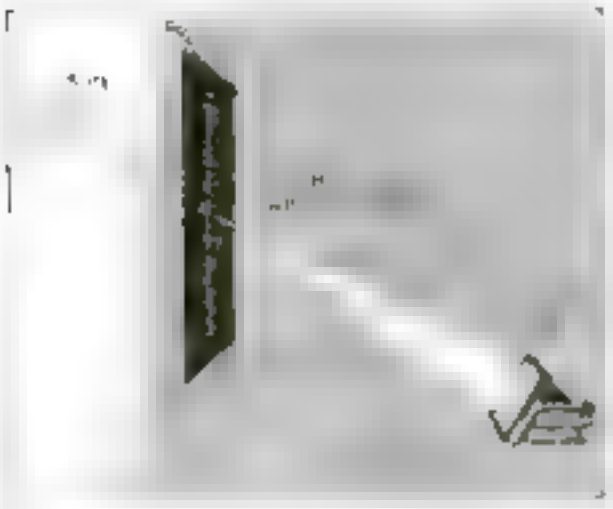


"WOBBLE METER" SHOWS FATIGUE OF WORKMEN

In the photo above is shown the "wobble meter," a machine that measures human fatigue. When the subject stands on a low platform that teeters forward and sideways, two little dials add up the wobbles. They are a direct measure of his tiredness

An Akron, O., firm of automobile tire manufacturers plan to try the device on its employees, so that their jobs can be arranged to suit their proneness to fatigue. The device is said also to indicate which vibrations in automobiles are tiring and which restful.

MEASURE THE SUN WITH YOUR POCKET RULE



FEW people realize that the oval disk of light that is seen on the floor of a darkened room wherever a pencil of sunlight filters through a chink in the blinds is an actual image of the sun.

The oval shape is a mere distortion. If a piece of cardboard is held at right angles to the pencil of light, the image becomes a circle whose diameter can be measured and made the basis of a fairly accurate calculation of the sun's diameter.

To secure the maximum accuracy possible in making the experiment observe the following conditions.

Select a time when the sun comes in at such an angle that the solar image can be made to fall on the floor at least ten or twelve feet from the window. Then draw down the window shade and make a pinhole in it at such a height as will throw an image the required distance. Fasten a sheet of white paper to a book cover and prop the book at right angles to the slender cone of light. The book must be exactly at right angles to the sun's rays. Any error will make your calculated figure too high or low.

Make two short parallel marks on the paper, just inside the bright image, and move the book and paper slowly toward the window until the disk exactly fits between the marks.

Measure the distance between the marks with a rule reading to sixty-fourths or half millimeters. Also measure exactly with a nonelastic tape or cord, the distance from pinhole to sun's image.

As soon as we know the distance of the sun from us (93,000,000 miles), its diameter can be calculated from the data now available. Assume that the pinhole's distance from the image is ten feet 5.5 inches, and that the diameter of the solar image is 1.175 inches. Then this simple proportion will give the answer:

125.4 in. : 1.175 in. :: 93,000,000 : x

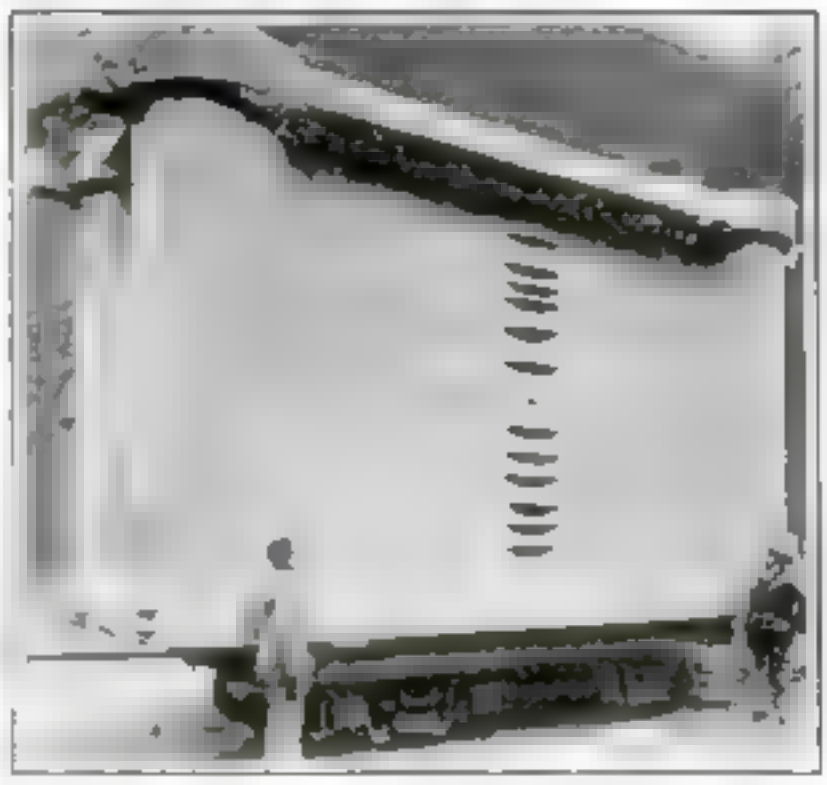
The value of x comes out 871,000 miles, or only about 1/140th part larger than the astronomers find the sun's diameter by much more refined methods.

MIGHTIEST CASTING WEIGHS 230 TONS

A GIANT among castings is the cylinder jacket for a huge 14,000-ton forging press constructed recently at Bethlehem, Pa. It is made in one piece and weighs 230 tons, 460,000 pounds, or about as much as a large locomotive.

SIX furnaces working at one time supplied the melted metal for making this titanic casting, said to be the largest ever poured. Comparison with men in the photo shows its size.

Making and handling this piece of metal taxed the capacity of one of the largest steel foundries in the United States. The press for which the new gigantic jacket is intended is part of the equipment in the Bethlehem plant.



Six Bethlehem furnaces ran at the same time to melt metal for this giant casting, the biggest ever poured.

Crackling paper as a broadcaster reads, annoys radio fans. A crackleproof paper is being tested.

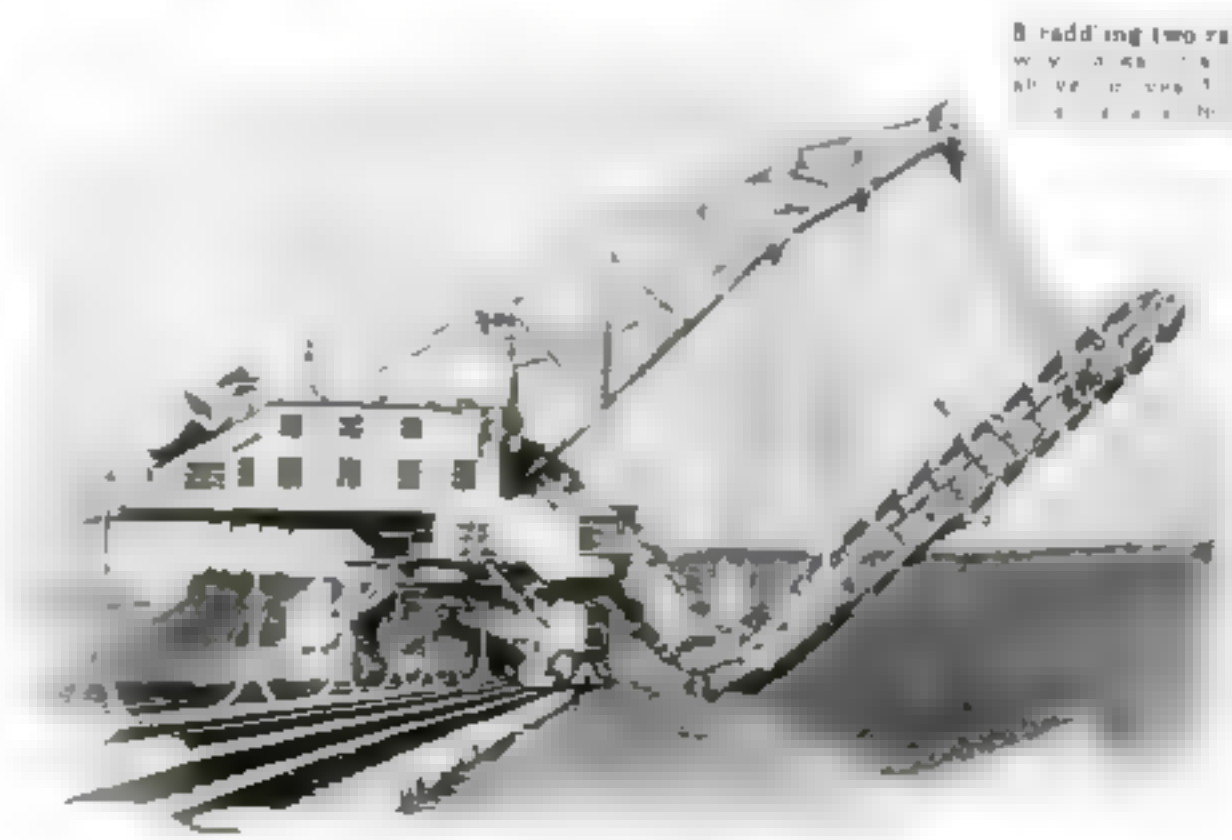
BROADCASTERS TEST SILENT PAPER

LEST the rustle of a speaker's notes destroy the illusion of spontaneity in his spirited oration, a large broadcasting company is trying out a "crackleproof" paper. If successful it plans to have all speakers use this style of paper for their written speeches.

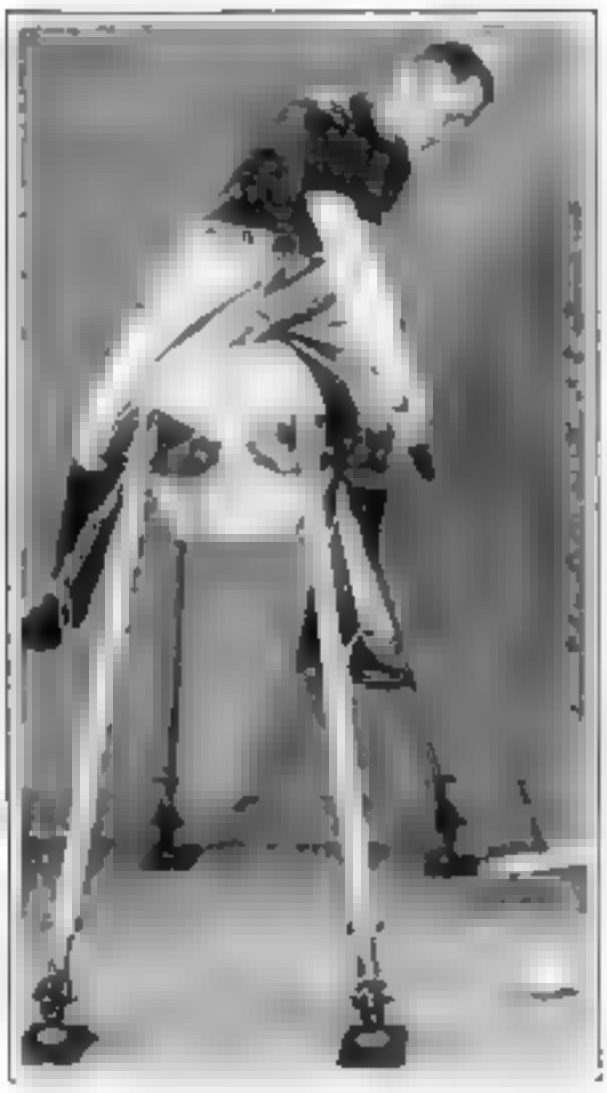
Most radio orations are read, not spoken extemporaneously. A speech must fit a rigid time schedule. Hence the need for a written draft and for a silent paper.

BIG COAL LOADER STRADDLES RAILWAY

AN ENORMOUS German "coal shovel" runs on the outer tracks of a four-track railway, straddling the two center tracks. The grotesque looking machine digs coal out of a huge storage pile and loads it into cars on the center tracks. Its swinging boom digs to a maximum depth of 100 feet. In an hour it loads about 1,242 tons.



Straddling two railways, it loads 1,242 tons per hour.



METAL POLO PONY USED IN PRACTICE

A polo pony made of metal helps Robert W Harasta, of Los Angeles, to improve his game. Harasta devised a make-believe mount from which he could practice

The product of his handiwork was a hobbyhorse standing on adjustable legs Changing their height gives Harasta a chance to experiment with strokes from ponies of different stature. Tilting the legs simulates any desired position of the pony

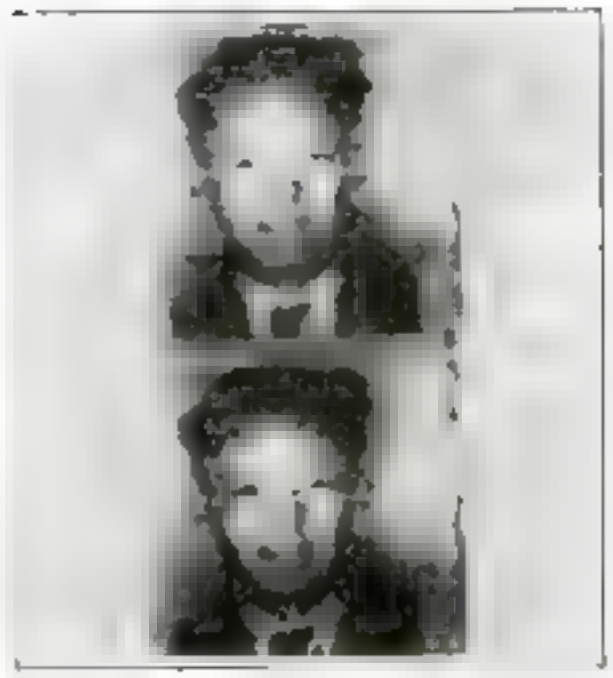
RESPIRATOR FOR BABIES MAY SAVE MANY LIVES

BABIES with breathing troubles at a Chicago hospital receive treatment in a strange looking machine

It is an artificial respirator, for use when tiny lungs have difficulty doing their work Feeding oxygen to infants through masks, or forcing their breath by mechanical means, often was injurious or irritating

The new method of mechanical respiration is said to be as gentle and free from ill effects as natural breathing. Similar machines were introduced a few months ago, in several American hospitals, for adult patients. It is expected, according to word from Chicago, that the use of the respirator will materially decrease infant mortality and at the same time save the lungs of the babies from injury

Chicago hospitals have installed a respirator for baby patients Picture shows nurse and doctor demonstrating it.



MOVING PICTURE MADE OF TELEVISION IMAGES

SUCCESSFUL photographs of television images, made recently at the Schenectady N Y., laboratory of Dr E F W. Alexanderson, give the man in the street his first view of "what television looks like."

Only a privileged few to date have been able with their own eyes to witness actual demonstrations of seeing at a distance, for at present television is admittedly still in the experimental stage. Even those who have seen television images find it difficult to describe exactly what they look like and to estimate just how clear they are.

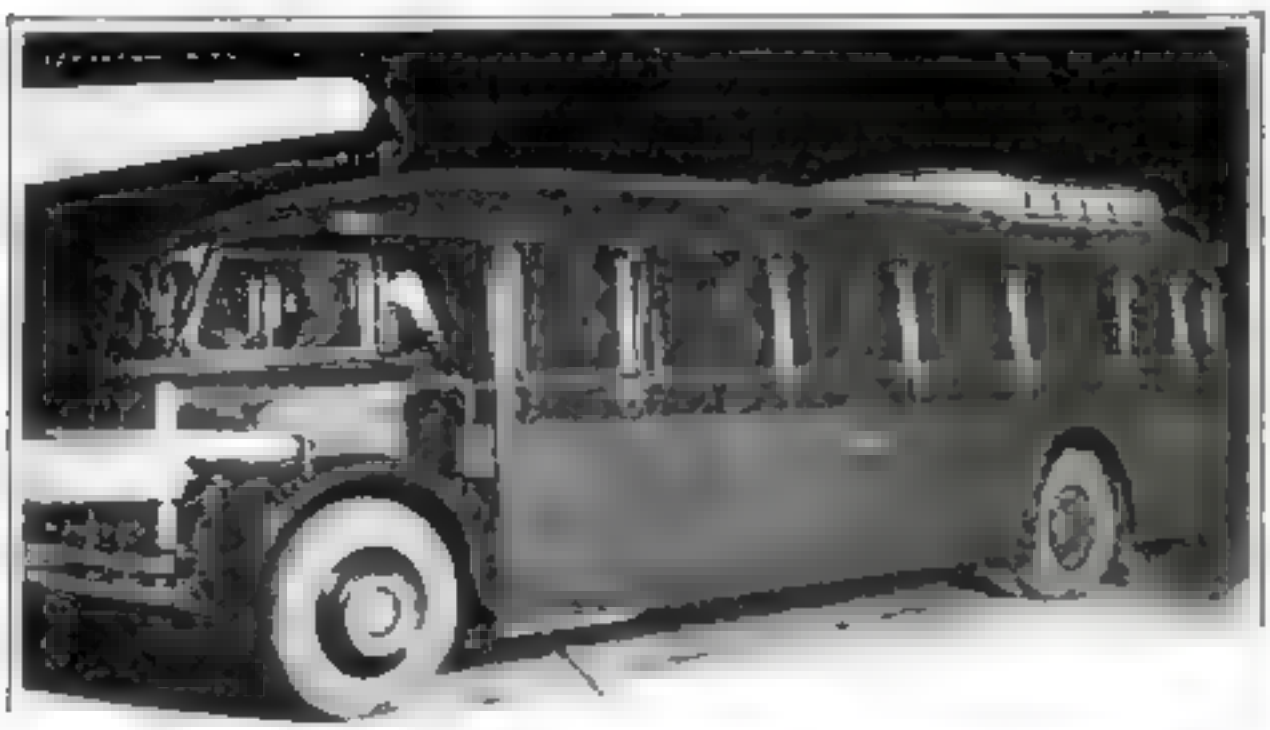
Now motion pictures of the image have been made at the receiving end, with the aid of powerful light sources made possible by a new type of light control valve. The movie film is placed in position in the aperture where the image is usually viewed, and records twenty pictures a second of the moving image. It is synchronized to keep in step with the number of images transmitted each second at the sending end.

The finished film, after development may be run off in a theater projector, reproducing the television broadcast The last fact suggests the possibility of theaters showing "television" news reels of current events from distant parts of the world, received and developed at central stations within a few minutes of the event

BUS FOR INDIAN PRINCE CARRIES 27

WINDOWS that you can see out of, but not in through, a sliding roof to let in sunlight by day, and a 225,000-candlepower searchlight to illuminate the way at night are features of two motor buses just completed in England for an Indian prince.

According to the firm that built them, it is doubtful if any two vehicles of such power and speed, and of such ornateness and luxury have ever before been sent to the East. They will be used by the Maharajah of Patiala on his hunting expeditions. One of them, the official traveling coach, seats twenty-seven persons.



Biggest and most ornate of the buses made for princes of India is this one, recently completed in England. It will carry twenty-seven persons and will be used on hunting trips.

MAINE COAST LEADS COUNTRY IN FOG

IN WINNING the honor of being the foggiest part of the United States for 1930, the coast of Maine took first second and third places. Moose Peak Lighthouse won first place with 1,526 hours of fog. Libby Island and Petit Manan, also on the Maine coast, won second and third places. Fourth place went to Point Reyes, on the California coast, where there were 1,393 hours of fog. The record for any year so far is held by Seguin Light, Me. In 1907 2,734 hours of fog were recorded at that part of the Maine coast.

REVOLVING FLOWERPOT TURNS PLANT TO SUN

EVERY part of a plant's foliage gets its share of sunlight with a new "sun-chasing" stand for a flowerpot invented by a Winchester, Mass., man. The stand revolves on ball bearings at the finger's touch. Given an occasional turn it protects plants against becoming lop-sided from unequal growth. The new aid to plant lovers is made in a variety of sizes, and is especially convenient for heavy pots that under ordinary circumstances are awkward to turn. It also serves as a watertight metal saucer beneath the pot. The device consists merely of the revolving base upon which the pot is placed. For large plants the saucer, not being needed is inverted and the pot is placed on it

TRIPOD ON WHEELS TO SHIFT MOVIE CAMERA

IN PRODUCING talking pictures, it is often necessary to move the camera while the scene is being filmed and the sound to accompany it is being recorded.

The most recent device to facilitate this operation without noise or jar is a flexible camera mounting by which the tripod can be mounted on wheels and the entire outfit moved to a new position.

With the new mounting, the camera can be moved to another spot, the tripod lowered to the ground, and set firmly in a stationary position.

A new mounting that raises the tripod on wheels makes it easy to shift motion picture camera from place to place.

OLD AGE DUE TO BAD DIET

SLOWING down the blood stream by self poisoning according to Dr. Arnold Lorand, of Carlsbad, Germany, is one of the principal causes of old age. It is brought about by eating insufficient supplies of mineral salts and gland stimulating chemicals. By including these elements in the diet, Dr Lorand believes it might be possible to prevent premature old age. The best way to do this, he says is by a diet composed largely of milk and milk products, like butter and cheese brown bread, fresh vegetables and fruits.

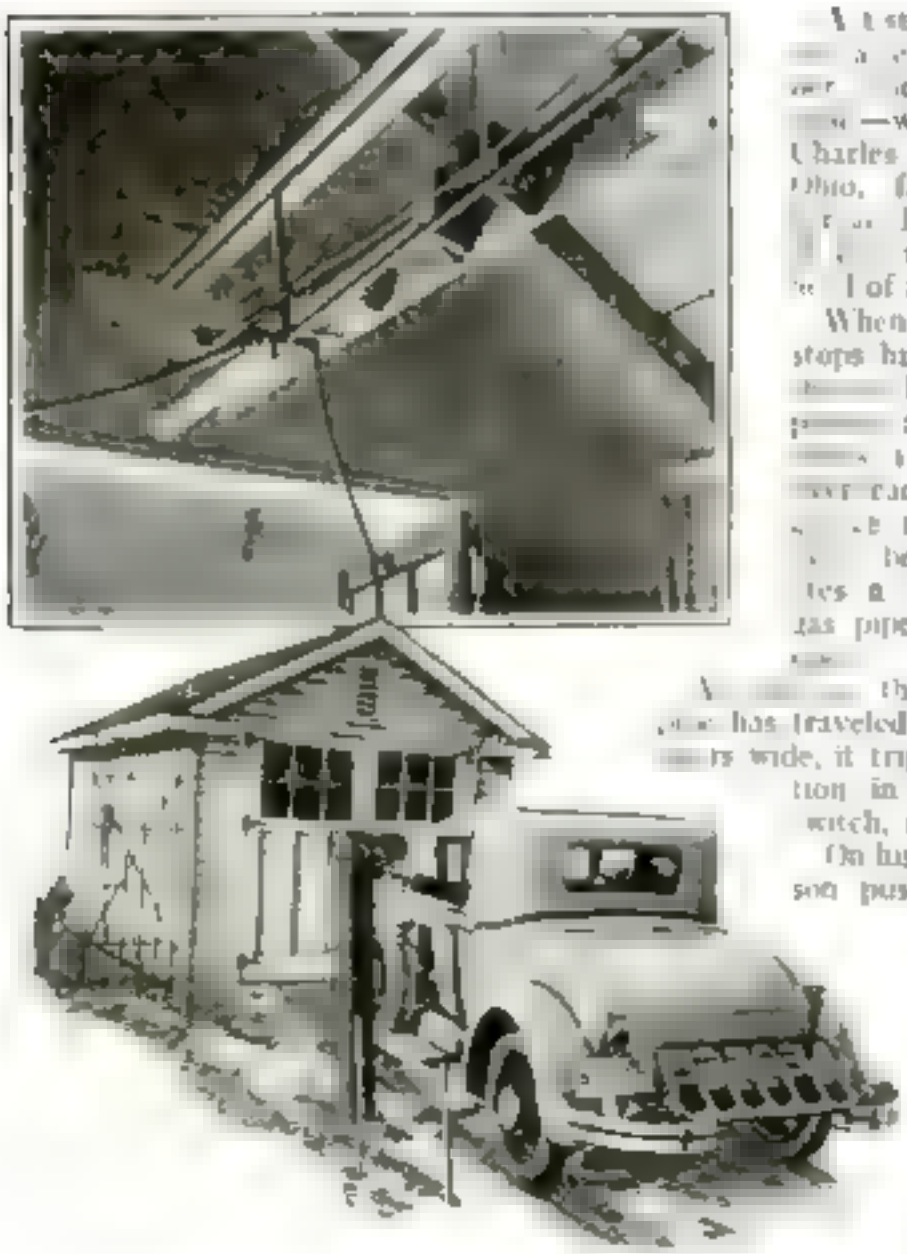
WELDING BIG BUILDING ENDS RIVET RACKET

A YEAR or so ago the board of directors of a New York City trust company sent out engraved notes of apology to some 500 of its neighbors, asking their indulgence "during the unavoidably noisy weeks" that would occur while rivets were being placed in its new building.

More recently a Cleveland, Ohio, trust company added part of another floor to its twenty-odd-story building, but sent out no apologies for noise. They welded.

The unusual photograph below shows a workman on a girder twenty stories above a Cleveland street. He is a grotesque figure with his bulky helmet and his sputtering welding torch, yet he personifies the modern, silent way of building.

BUILDS HIS GARAGE DOOR OPENER



Washing machine motor, rope, and pieces of gas pipe are rigged into this garage door opener put in operation with push button.

A used washing machine motor, a length of rope, some lumber and a few pieces of gas pipe—with these materials Charles Johnson, of Cleveland, Ohio, fashioned an automatic garage door opener that has given unfailing service without need of maintenance or repair.

When Johnson drives in, he stops his car at a control post, puts his key into a lock, and presses an "open" button. This starts a motor mounted on an overhead platform within the garage and revolves an improvised belt of rope which actuates a framework of half-inch gas pipe that pushes the doors open.

When the operating end of the pipe has traveled far enough to open the doors wide, it trips a small metal projection in its path and opens a switch, stopping the motor.

On his way to the house, Johnson pushes the "close" button and the doors shut themselves, automatically stopping in the closed position.

"This device," says Johnson, "saves me jumping out of the car to open and close the garage doors and is an effective lock because it is impossible to open the doors without setting the motor going."

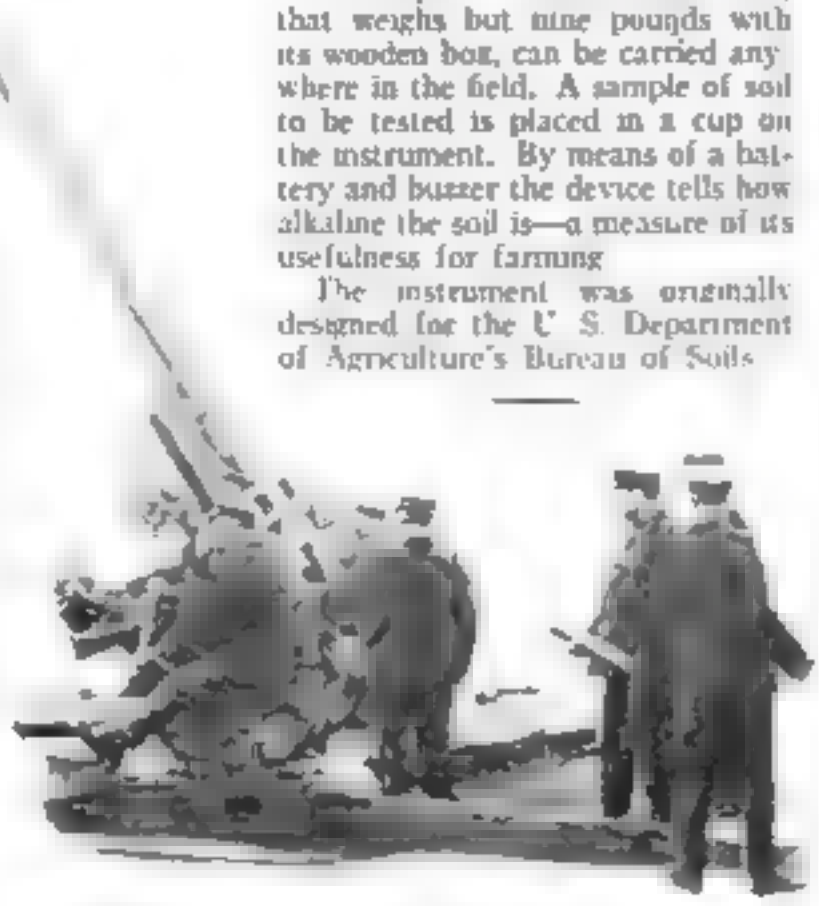
Courtesy Lincoln Electric Co.

The strangely dressed figure on the girder is welding a joint, the process that ends riveting.

NEW GUN HURLS SHELL FIVE MILES STRAIGHT UP

THE newest war terror is an anti-aircraft gun, built in England, that could fire a shell over the top of Mt. Everest, world's highest peak. The weapon's extraordinary vertical range enables it to destroy airplanes flying as high as five and a half miles above the earth's surface. Few planes climb higher.

Developed according to an entirely new pattern by the famous firearms concern of Vickers, the gun is controlled by a device that holds it automatically on the target. It can fire its fifteen pound shells in any direction whatever, and is a deadly weapon against tanks and armored cars as well as airplanes. Used at lower angles, it can shell objects eight miles away at the rate of twenty-five rounds a minute. Guns of the same design will be built having a still greater range.



Anti-aircraft gun that throws a shell five and a half miles

ELECTRICITY TESTS SOIL FOR CROPS

NOW electricity tests your soil and tells you what sort of crops you may expect from a hitherto unused piece of land.

A compact electric instrument, that weighs but nine pounds with its wooden box, can be carried anywhere in the field. A sample of soil to be tested is placed in a cup on the instrument. By means of a battery and buzzer the device tells how alkaline the soil is—a measure of its usefulness for farming.

The instrument was originally designed for the U. S. Department of Agriculture's Bureau of Soils.

This soil tester, which consists of a battery and a buzzer, tells how alkaline the earth sample is

FLAT HAILSTONES FALL ON ISLAND OF CYPRUS

"FLAT" hailstones, shaped like coins, were a novelty that fell recently on the island of Cyprus. They melted first at the centers, forming doughnutlike rings.

Recently reported to the British Meteorological Office in London, they remain a curiosity for which that office is unable to give an explanation.

SERVE FOOD ON ROTATING BUFFET

"MERRY-GO-ROUND" lunch counters are the newest idea in restaurants. So far a dozen of these unusual eating places with revolving tables have been opened on the Pacific coast. They introduce an entirely novel idea in service, and do away with the necessity of employing a staff of waiters.

The diner seats himself at a large round or oval counter. Before him passes continually a tempting array of food in glass cases, moving slowly on a revolving counter or an endless belt. Wherever he sees a dish that appeals to him he opens the door of the moving case and takes out a portion of his favorite food.

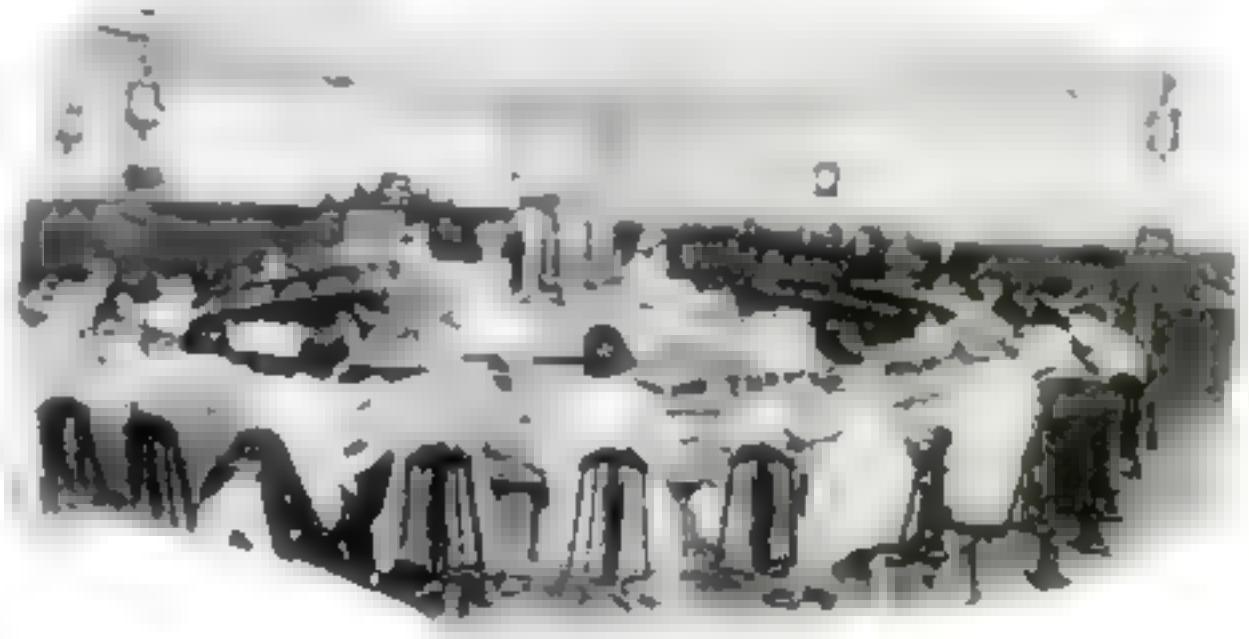
Pies, cakes, salads and fruits thus pass in review, and all the water desired may be had for the taking. On leaving the restaurant the diner pays a fixed charge regardless of how much he has eaten.

The twelve tables now in operation, all installed by a central company, are expected to feed nearly two million people during the present year, and it is planned to open additional tables in the near future in various cities throughout the United States and perhaps, if these are successful, in Canada.

LETTERS FOR SIGN HELD IN PLACE BY MAGNETS

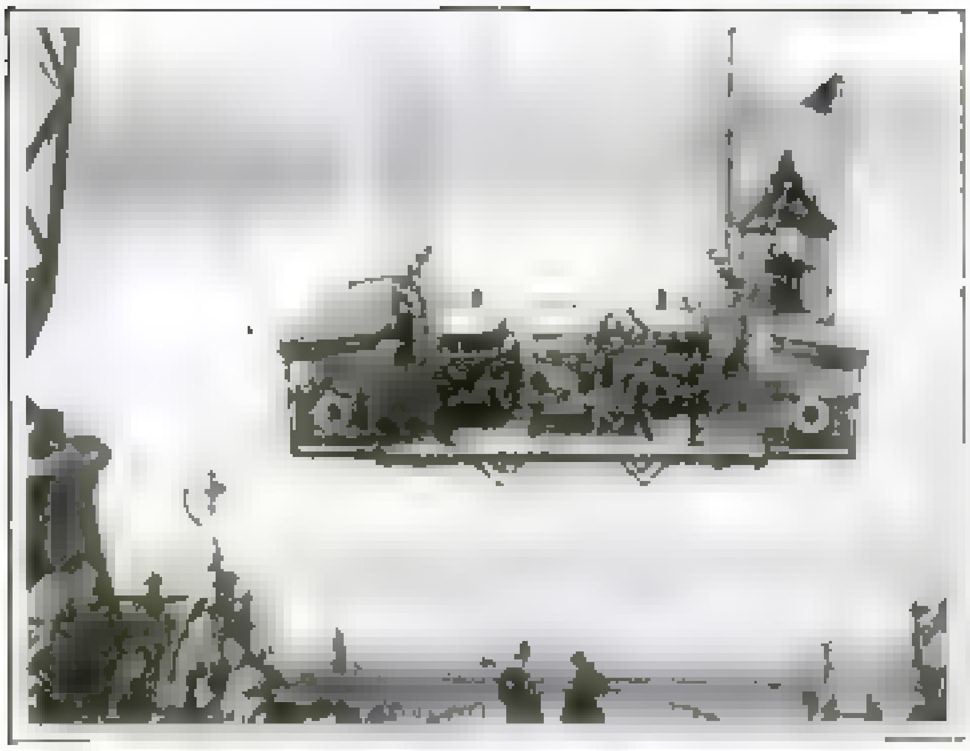
MAGNETIZED letters are used in a new type of sign perfected recently by an Omaha, Neb., firm. Mounted on a background of steel, they are held against it by the magnetic force. Both background and letters are made in varying sizes, each letter having two or more magnets in its back, depending on its size. The letters need not be in a straight line, but can be placed in any arrangement. The magnets are said to be powerful and will last for several years.

Applying to lettering the principle of the horseshoe magnet, with which most schoolboys are familiar, has resulted in a window display sign that can be changed easily from day to day. Storekeepers who have used it find it a convenience in announcing sales and marking the price of their goods.



Food in glass cases constantly moves in front of the diners at this merry-go-round lunch counter, tempting the patrons to take anything that particularly appeals to them

Odd Ferries, *New* and *Old*

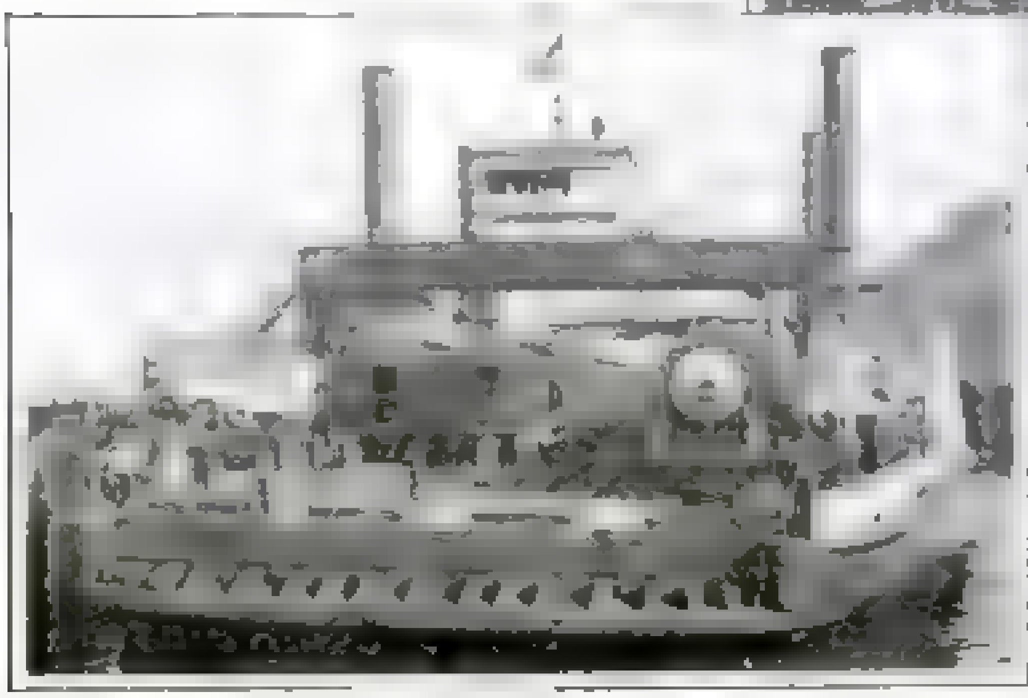


SWINGING [illegible]

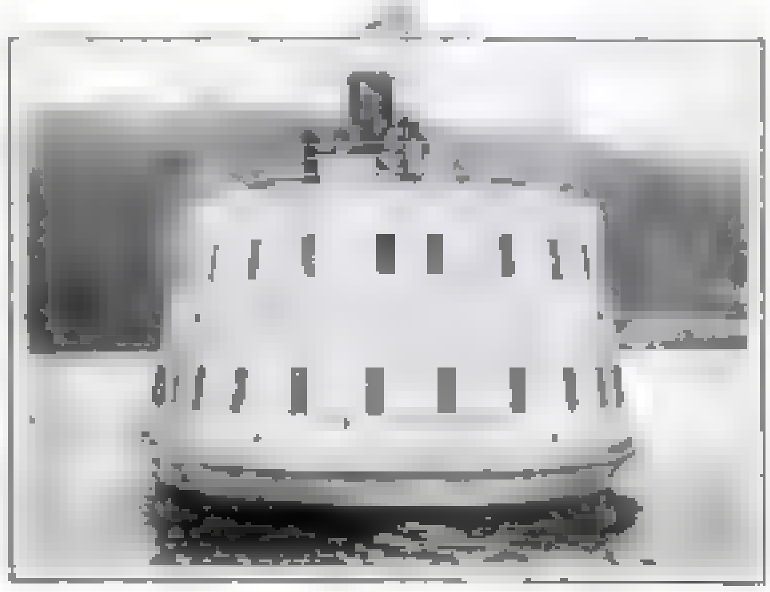
LAST OF [illegible]

WHERE SPEED IS NO OBJECT. [illegible]

AG[illegible]

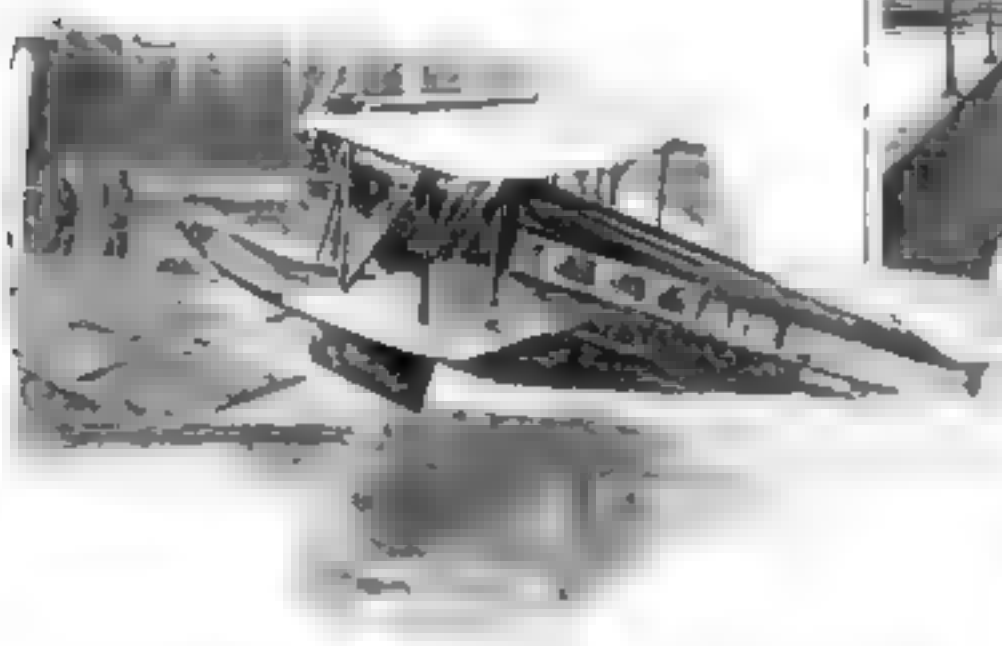


WORLD'S BIGGEST QUITS. Here is the *Contra Costa*, largest boat of the k[illegible] in the world. For years [illegible] craft ferried across the Carquinez Straits, Cal. Now a bridge has put an end to [illegible]

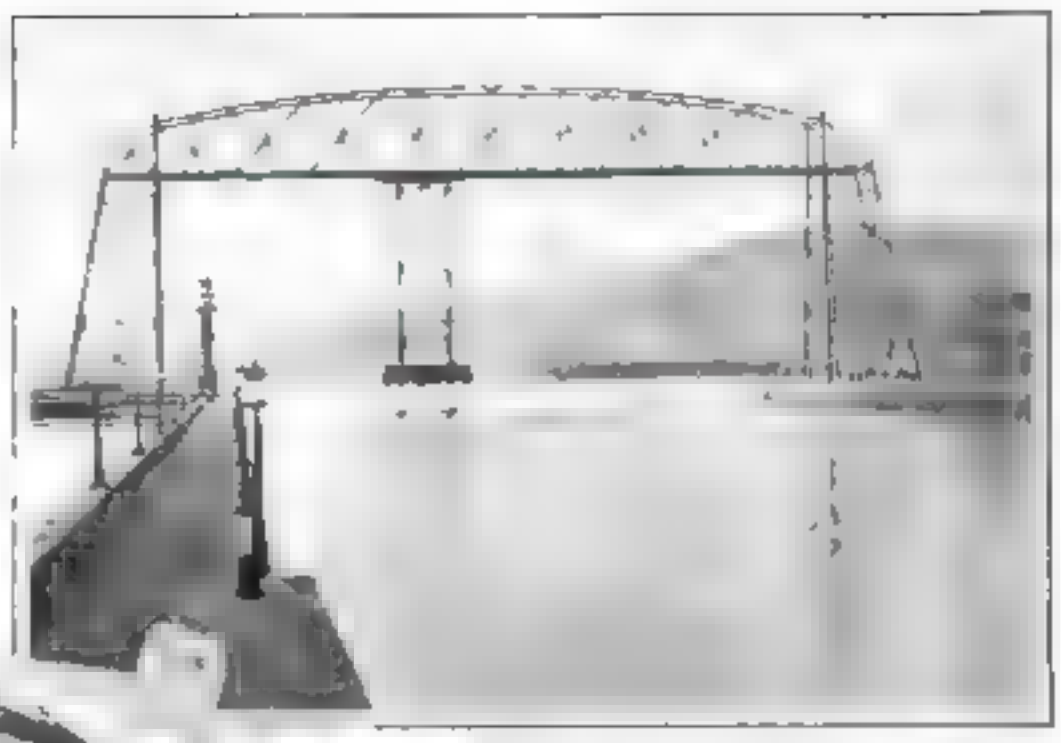


ARK IS ON THE JOB. A [illegible] an old Quebec ferry [illegible] has long been in use on the St. Lawrence. Because of its peculiar appearance it is known as the "Ark

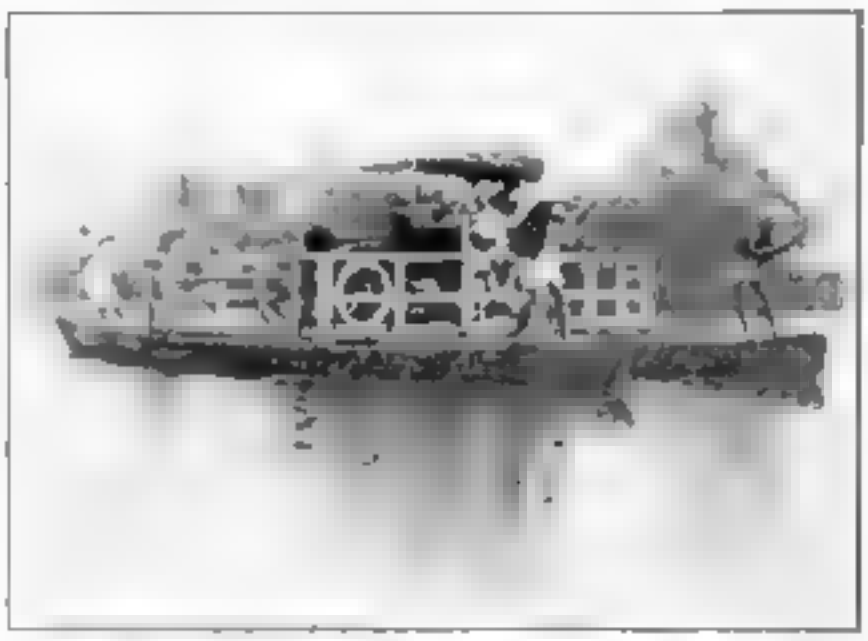
Photo Story of Strange Craft From the Airplane Service of California to Primitive Boat Run by Man Power in India

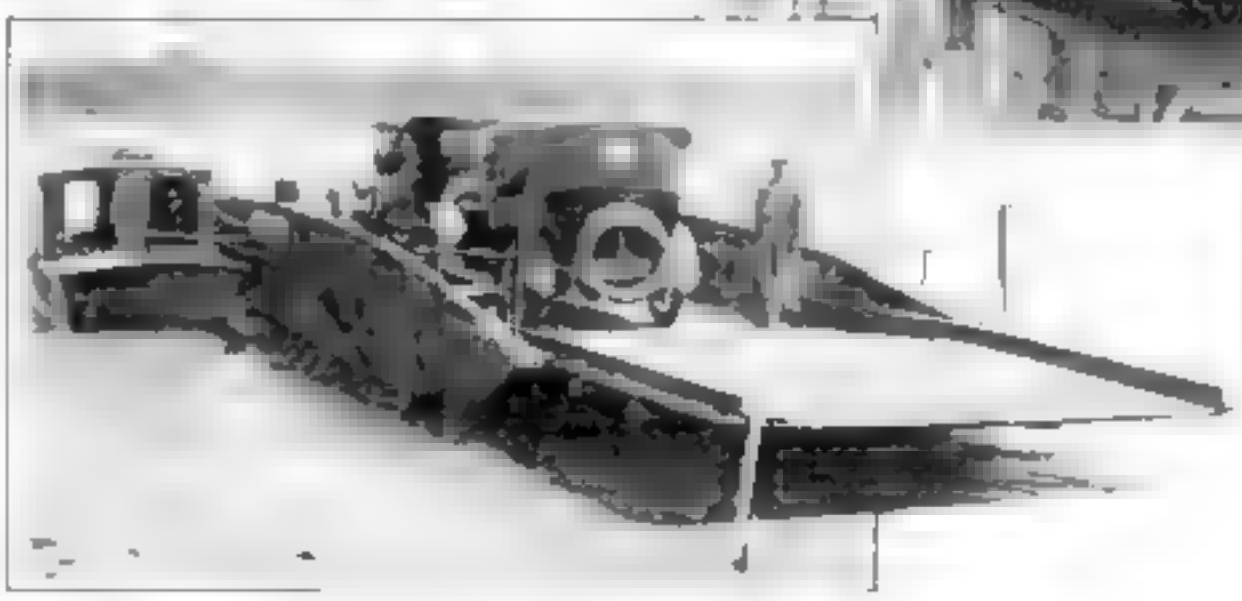


FERRYING THROUGH THE AIR This new air ferry has just been put into use between Oakland and San Francisco Commuters find the time for the trip greatly reduced as this plane cuts it to six minutes

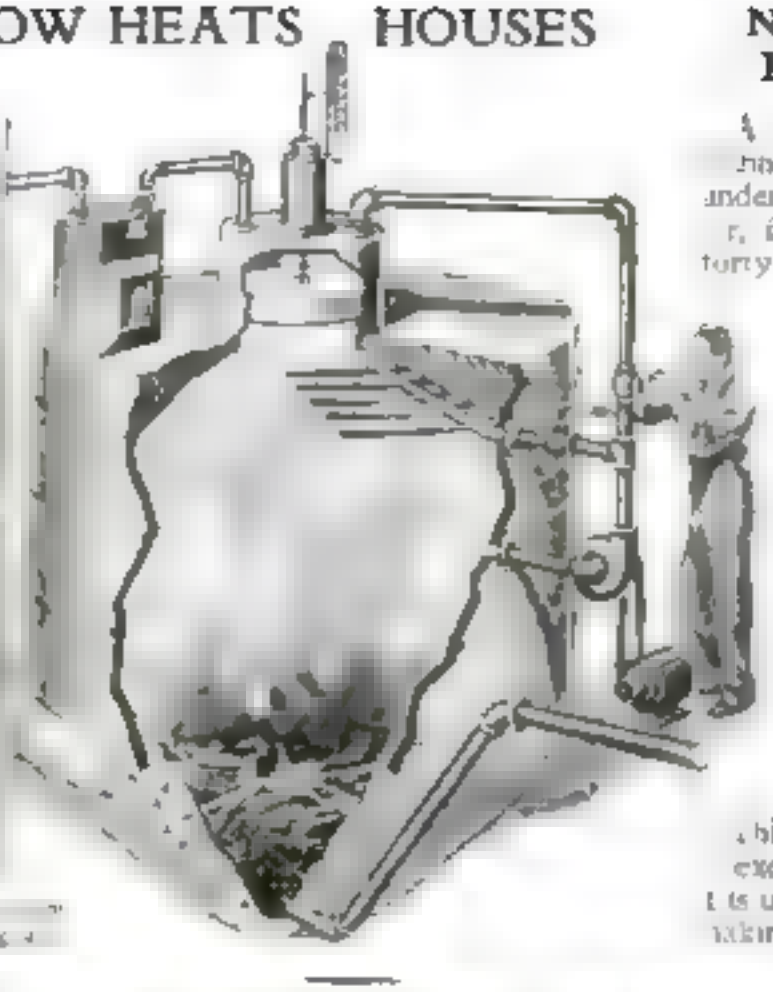


NO LONGER A FERRY BRIDGE For years Duluth, Minn boasted the only aerial bridge in America On it commuters were swung across the Lake Superior ship canal. The number of patrons has now increased so enormously that it has been turned into a lift bridge





GAS FROM WASTE NOW HEATS HOUSES



CHEAP gas produced from cornstalks and sewage may soon be lighting and heating homes in the corn belt, according to Dr A. M. Buswell of the University of Illinois. Recent experiments show that these farm wastes, when placed in a tank eight feet square and eight feet deep, will provide all the gas needed by the average family. No complicated and expensive equipment is needed. Bacteria present in these wastes manufacture the methane gas on a process of fermentation.

The installation of a fermentation tank costs approximately $300.

NEW MACHINE BORES HOLE UNDER STREET

A MACHINE, invented by a California engineer, bores horizontal holes for pipes under streets. Operated by compressed air, it can dig small tunnels as long as forty feet from the starting point at one setting of the device under working conditions. In tests it has dug horizontal holes for a distance of one hundred feet.

A ratchet feeds the drill into the hole. After the cut has been made the feed ratchet acts as a winch for hauling pipe or cable through it. On the motor end of the machine, a connection forces water through to the drill point, where it emerges and washes the cuttings back to the mouth of the hole. It is claimed the machine overcomes gravity and does not bore a declining hole.

This machine has proved a convenience in excavations for small pipes in cities, as it is unnecessary to break the paving when making such excavations.

TEXAS BUMPS CONTROL FAST CAR DRIVERS

A SERIES of bumps, about a foot high extending across streets at intervals, is solving the speed problem in the residential section of Fort Sam Houston, Texas. Traffic rules set a speed limit of twelve miles per hour. Serious violation of this limit is prevented by the series of bumps recently installed, which make fast driving uncomfortable and dangerous. A driver striking the bumps at touring speed gets a good shaking up, while a fast driver is thrown about dangerously. Most drivers need no second lesson to induce them to observe the speed limit.

Hitting the bumps in Texas, where the streets are crossed with ridges to be sure the speed law is obeyed.

WALL PAPER CLEANS LIKE FLAT PAINT

SOAP and water won't hurt a new washable wall paper coated with a cellulose material developed in the laboratories of the Du Pont company. Samples of this paper resisted 5,040 rubbings with cheesecloth, soap, and water before showing signs of wear. Between each rubbing it was allowed to dry at room temperature and dust from the floor was rubbed upon its surface. No difficulty was experienced in removing this dirt. These tests indicate the paper wears as well as flat wall paint.

Wall paper is now available that withstands soap and water and washes like flat paint.

WHY SAVAGES ARE HEALTHY

HAVE you ever wondered how savages living under insanitary conditions, with no knowledge of diet, keep healthy? Carl van Noorden, Viennese doctor, believes it may be due to two factors—sparing use of salt and unfertilized cultivation of the vegetables they eat. Salt, he says, reduces the blood's ability to resist disease. Civilized man uses too much of it, while the savage generally uses but little, to the benefit of his health.

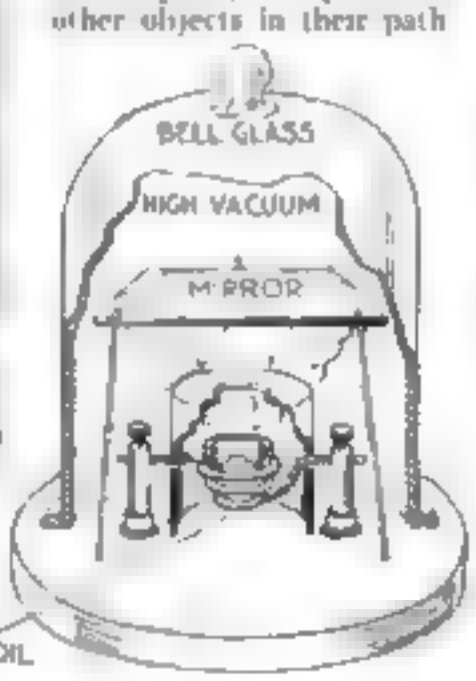
The savage usually raises his crops without fertilizers, with the result that his vegetables are rich in iodine and iron.

ELECTRICITY USED TO COAT MIRRORS

AT LAST a way to give scientific mirrors a durable coating has been discovered. Silvering them has always been a problem, since the shiny coat must be on the front of the glass—unlike that of a boudoir mirror—and consequently is exposed to the air's tarnishing effect.

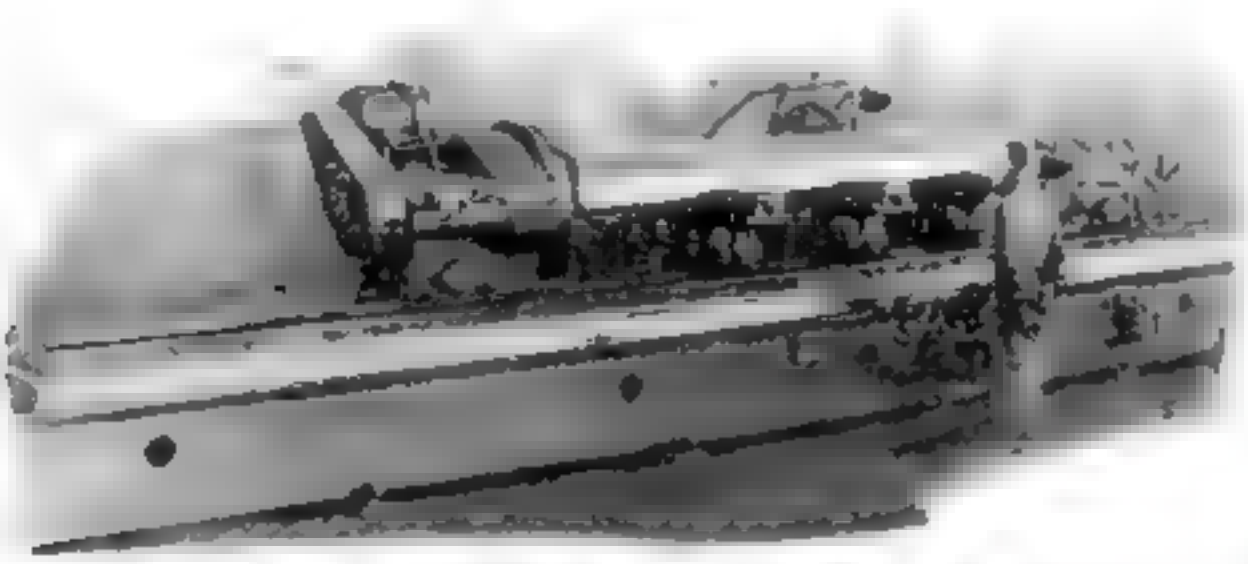
Lately, however, silver films, protected by coats of quartz one one hundred thousandths of an inch thick, have been deposited on glass, paper, and the like by Doctors C H. Cartwright and John Strong, of the California Institute of Technology Their apparatus resembles a huge electric light globe, using instead of a lighting filament a heating coil of platinum or tungsten wire

The plate to be coated is suspended above the filament, inside the container A small bit of the coating material, loose or in a tiny crucible, rests in the filament coil. After the air is exhausted from the jar, an electric current evaporates the crucible contents, and the escaping atoms, unhindered by air, coat plate and other objects in their path



Above demonstration of new mirror coating method, made clear in diagram at right.

GIANT GRINDER FAIRLY EATS METAL



Biggest grinding machine in the world with a fifty-seven-foot base weighs over 36,000 pounds and eats metal at the rate of six cubic inches in a minute.

A GIANT among grinding machines was completed the other day by a tool manufacturing firm in Worcester, Mass. It is said to be the largest machine of its kind in the world. Comparison with the man in the photo gives an idea of its size.

Huge steel or iron rods, as large as three feet in diameter and twenty feet long can be handled on it. In a trial of the machine, its rapidly spinning grinding wheels chewed metal at the rate of six cubic inches a minute

The enormous machine, fifty-seven feet long, and with a base weighing over 36,000 pounds, was built for a hydraulic press manufacturer who will use it in finishing parts for his heaviest presses. The wheel is driven by a thirty-horsepower motor

HEAD NET WITH WINDOW KEEPS MOSQUITOES OUT

FREE from annoyance by insect pests as the fisherman who dons a new head net Unmindful of them, he can tramp through the most mosquito-infested marshes, nor can gnats and black flies and other insects get at his face

The net fits over any hat, and is attached to a collapsible steel frame. A nonbreakable noncombustible window in the front gives clear vision, unobstructed by the meshes of the net. There is even an aperture for the sportsman's pipe When thus equipped, and wearing mosquito-proof clothing and boots or puttees, the sportsman's immunity is complete

NEW PORTABLE FILTER INSURES CLEAN WATER

CAMPERS or tourists may get clean water almost anywhere by using a small filter developed recently by a Chicago, Ill., firm. The filter, to which a length of rubber tubing is attached, fits over the necks of one-gallon or two-gallon bottles. The other end of the tube is put into water in a kettle or pan close by. A pump then extracts the air from the bottle, making a vacuum that draws water through the filter from the pan into the bottle. Where water is suspected of being contaminated it should be sterilized with chlorine tablets before filtering, as the filter, of course only takes out the dirt

Portable filter apparatus, working under air pressure, insures clean water for tourists.

ELECTRIC HOTBED HEATER RUNS ITSELF

This bed spring like electric heater for hotbeds has a thermostat that automatically adjusts the temperature.

A device recently placed on the market by a Detroit, Mich., manufacturer, is an electric heater for hotbed sections in greenhouses. It resembles a steel bed spring since it consists of a light angle-bar frame across which the heating elements are stretched. This is slid under the beds in which hothouse plants are raised. It automatically maintains an even temperature at all times by means of a thermostat.

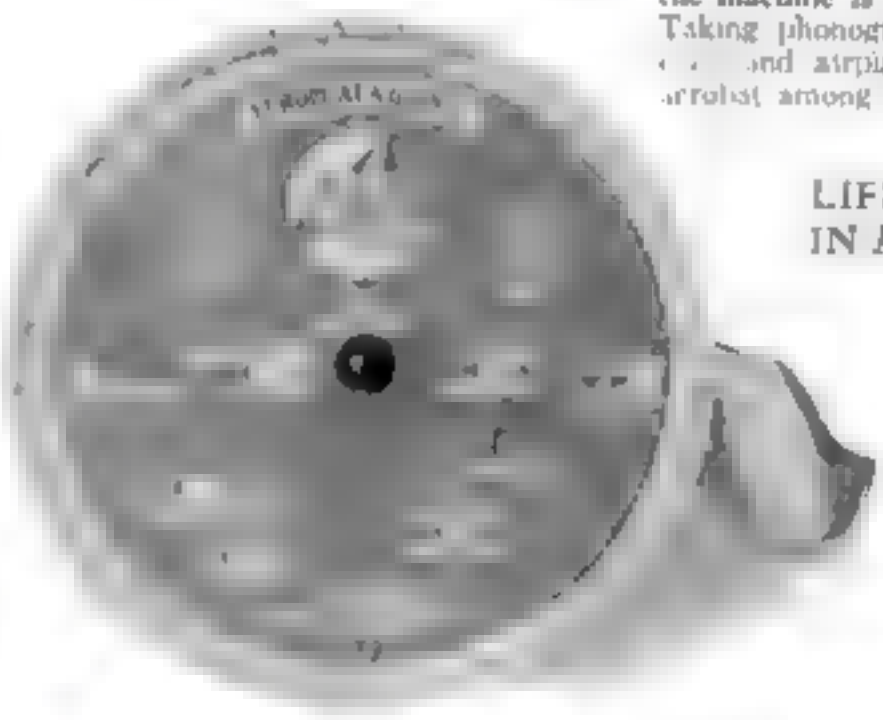
The temperature is adjustable from fifty-five to ninety-five degrees Fahrenheit. This heater can be used for outdoor plant and flower beds as well as those in greenhouses. It uses alternating current at 110 to 115 volts. Nine square feet of bed surface can be handled by one heater section.

ENGLISH PHONOGRAPH PLAYS UPSIDE DOWN

A new British phonograph plays records at any angle. It is fitted with a specially-balanced tone arm that remains in contact with the record regardless of how the machine is tilted—even upside down. Taking phonographs out in small boats, [illegible] and airplanes made necessary this arrival among talking machines.

GIANT SEAPLANE *DO-X* LIFTS FIFTY-FIVE TONS

On its much-delayed way toward South America from Germany, the giant German seaplane *DO-X* recently set a new world's record for heavier-than-air machines. In a test flight it lifted a total load of fifty-five tons into the air.



BALL-TIRE MOTOR BIKE WHEEL SKIDS SAFELY

A novel rear wheel enables a British motorcycle race driver to skid his machine around turns on dirt tracks. It has a grooved rim that carries a series of balls free to rotate on small axles. The device is like a large ball bearing, except that the balls rotate at an angle to the direction of the wheel moving forward over the ground. An advantage, according to its inventor, is that a rider can intentionally skid his machine without reducing its forward speed, making it easier to round sharp curves.

Balls used as a rear tire of a motor bike enable a rider to skid around corners in comparative safety

EDUCATED DISK GIVES DATA ABOUT NATIONS

This disk shows at a glance all of the salient points regarding the nations of Europe. By setting the pointer opposite the country about which information is desired, the disk shows the name and population of the capital city, the location of the country in Europe, the area in square miles, the population per square mile, the population of the country, the form of government, the name and length of the principal river, the name and height of the highest mountain, the standard time when it is noon in Greenwich, and the national colors. This information is given for thirty-four different countries of Europe.

The disk is about the size of an ordinary phonograph record and not half as thick, being made from two pieces of cardboard. The size and information presented make it an attractive novelty for schools.

LIFE-SAVER CLAD IN ASBESTOS SUIT

Ugliest costumed man aboard each of the naval aircraft carriers *Saratoga* and *Lexington* during recent maneuvers off Panama was a figure clad in asbestos. He dared not remove gloves or helmet for a second. He watched planes leaving and alighting on the decks. If one should catch fire it was his duty to rush in and drag the pilot from the burning craft before it was too late.

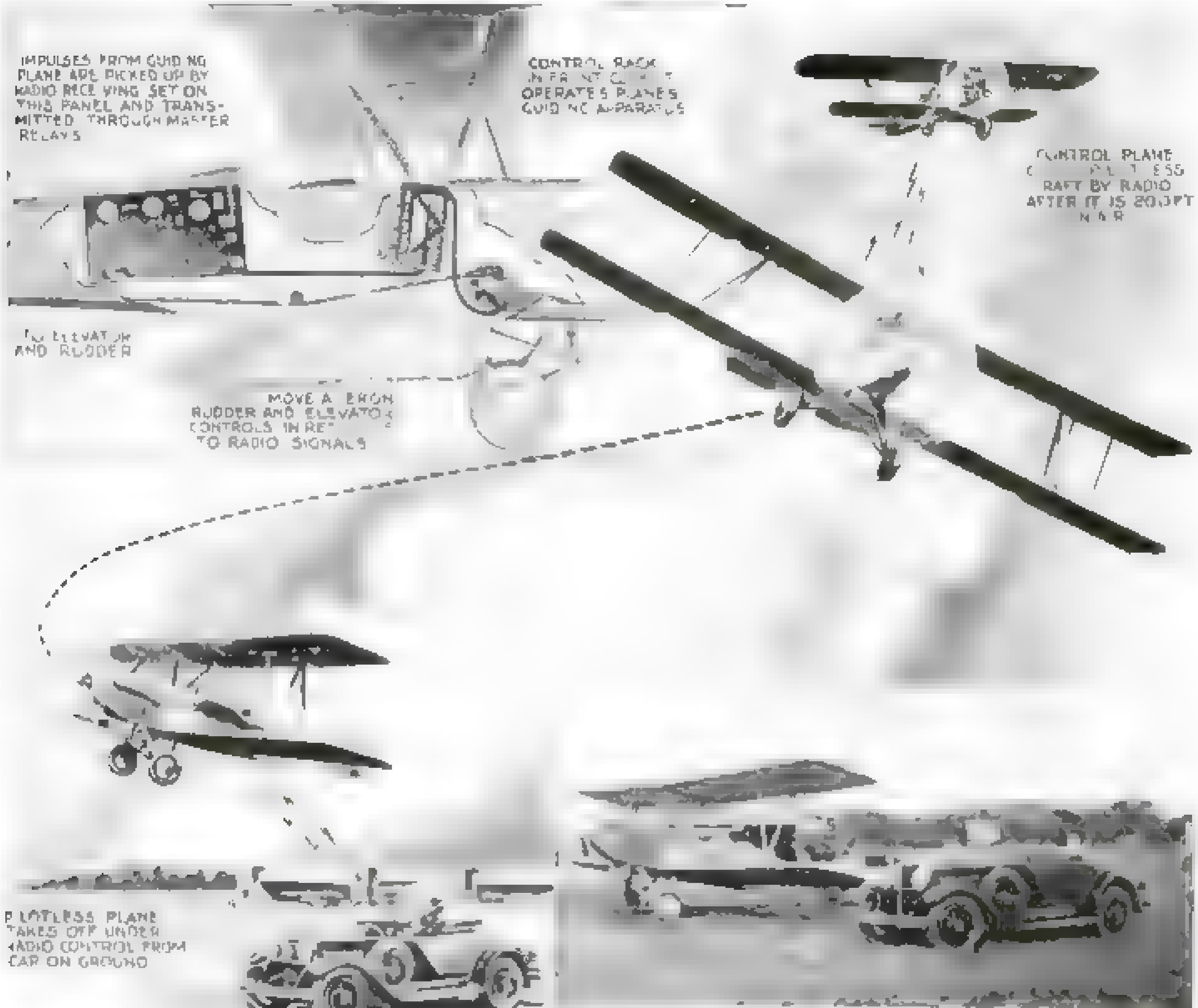
STUDIES SUN'S CORONA FROM MOUNTAIN TOP

Astronomers travel thousands of miles to observe the sun's luminous halo, or "corona," during a total eclipse, the only time when it may be seen by human eyes. But a French astronomer, B. Lyot, has now successfully tested on a mountain peak in southern France a way to trace the form of the corona without waiting for an eclipse.

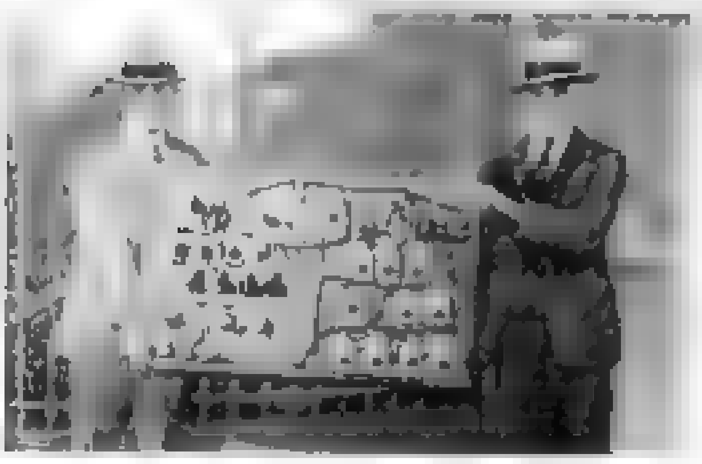
His apparatus consists of a telescope to form an image of the sun, an opaque disk to obscure the bright part of the sun's face, and an instrument that detects "polarized light" from the corona.

Polarized light, which is light vibrating in one plane only, is present in considerable quantities in the sun's corona and can be detected by suitable instruments known as "polarimeters." With such a device, Lyot reports that he has been able to find the limits of the corona's spread and draw diagrams of its form even though he cannot see it directly.

Pilotless Plane to Tour Country



Drawing shows [illegible]



Here is a view of the master radio control panel that takes the place of the human pilot in the pilotless plane.

A MODERN marvel of radio engineering—an airplane without a pilot, steered and controlled entirely by radio—is scheduled to start next month from Texas on a tour of 100 principal cities of the United States. POPULAR SCIENCE MONTHLY presents to its readers on this page the first published story and pictures of this radio wonder, which has hitherto been tested and flown in strictest secrecy.

When the pilotless plane is to take the [illegible] its motor is started. A [illegible] radio-equipped a[illegible] down the field, gu[illegible] its take-off. As [illegible] plane is two hundred [illegible]

[illegible]

been designated as chief operato[r] [illegible] the tour. She will sit in the guiding plane, tapping out signals on its thir[t]y watt, short wave radio transmitter, which is operated entirely on batteries.

Radiated from the wing aerial of the guiding plane, the code signals will shoot through intervening space and be picked up by a short-wave receiver on the pilotless plane's master control panel. Through the intervention of electric relays six-volt electric motors turn gears that operate the airplane's control rods. Each control is provided with a friction brake so that it will stay where the motor leaves it.

Wh[ic]h of sixteen [illegible] [to] be moved is determined by the coded radio signal. Two and a half seconds is the maximum time needed to operate any control. If the radio pilot drops the right wing for a bank, it remains down until she signals the plane to right [illegible] The equipment aboard the pilotless plane that the receiver, relays, control motors and four six-volt storage batteries weigh only 415 pounds.

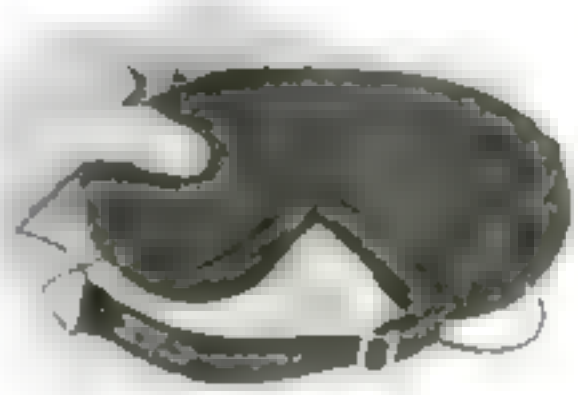
Dual tubes are used in both transmitter and receiver. If one burns out the other will automatically replace it, saving the pilotless craft from falling out of control. The radio apparatus can be altered to different frequencies in flight, to avoid interference from local radio stations.

Starting up the Pacific coast, the plane will visit every city of more than 500,000 population on its seven-month tour, among them Los Angeles, San Francisco, Seattle, Kansas City, Minneapolis, Chicago, Boston, New York and Washington.

CRADLE FOR SICK HORSE MAKES TREATMENT EASY

To aid a veterinary surgeon operate upon a sick horse, a unique revolving cradle-like operating table was recently installed at a "horse sanatorium" of Hoppegarten, near Berlin, Germany.

After a small injection of a narcotic to make him manageable, the horse is strapped in the special harness provided Then an attendant revolves a windlass and the invalid is unceremoniously upended. Lying comfortably on his side, the horse is in a convenient position for the surgeon to operate and at the same time is held so securely that it is unable to do any damage with hoof or teeth



NEW EYE MASK SHIELDS SLEEPER FROM LIGHT

That rarest aid to restless sleepers—a really dark room—is brought within the reach of everyone by a new "sleep mask" designed especially for the purpose of shading a sleeper's eyes. Padded with soft down, it fits lightly and comfortably over the face

Useful when sleeping on trains, in hotels and on sleeping porches, where electric lights often shine directly in the eyes, it aids sufferers from insomnia in the home as well. Modern lighting systems make it difficult to shut out reflections from street lamps and other artificial illumination, but a mask provides the equivalent of natural darkness. Late morning sleepers and those who take afternoon naps, as well as users of artificial sun lamps, may also find it helpful, according to the maker The mask covers only the eyes, so there is no interference with breathing

PAPER NOW MADE FROM TREE COMMON IN SOUTH

Dr Charles Herty holding a bunch of slash-pine seedlings from which paper is made.

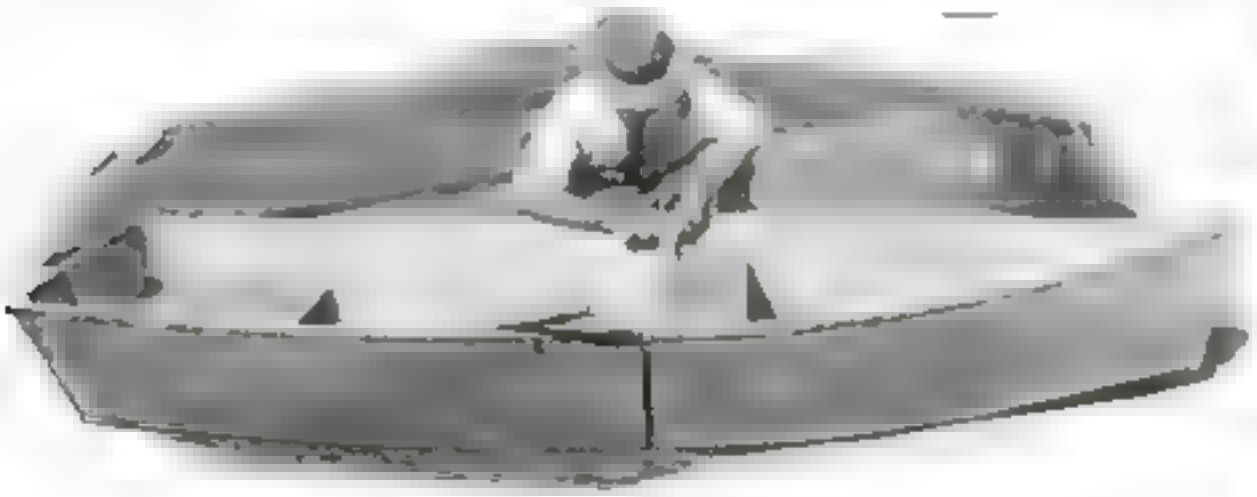
Dr Charles Herty, former president of the American Chemical Society, announced recently that "slash pine a tree with which the South abounds, may become a crop rivaling cotton in importance, following the discovery that it can be made into white paper and newsprint

Vast stands of pine trees in the South are at once available for paper-making by much the same process as that used in the northern woods. Alabama alone for example, has some 22,000,000 acres of potential timber land

TWO-PIECE ROWBOAT FITS BACK OF CAR

A new rowboat comes in halves, so that it can be stowed away easily for carrying on the back of a car. Arriving at the water's edge, the owner has merely to join the halves together to have a full-sized seaworthy sport boat No special water tight fitting is required, since each half is complete and able to float by itself. The two parts of the keel are joined together with pin-and-socket fastening, and the gunwales are fitted snugly with special toggle clamps with thumb nuts. The manufacturer claims it will carry a load of 700 pounds

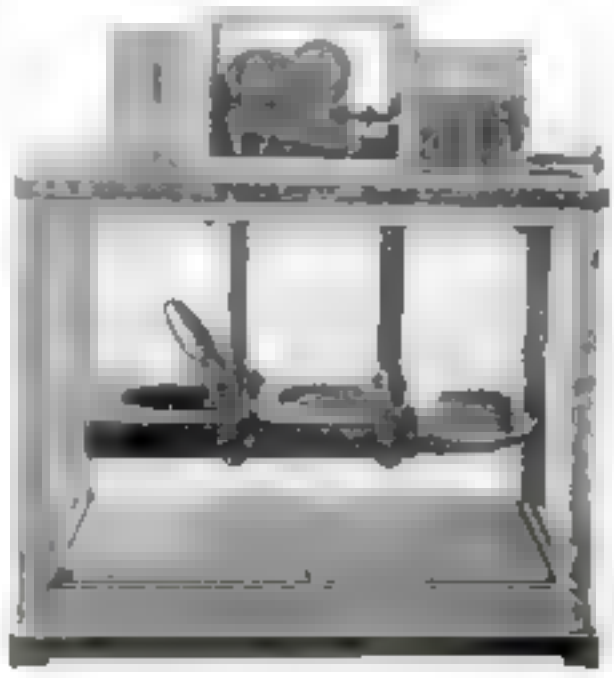
The boat is ten feet long when assembled It weighs 100 pounds with the oars making rowing easy even for children



Made in two sections, each of which is water-tight, this boat can be carried on the back of a car and the parts fitted together quickly and solidly at the water's edge.

PANCAKES FLIPPED OVER BY AUTOMATIC COOKER

Designed to take the place of human cooks, an automatic pancake cooker recently invented, flips the cakes automatically When its electric switches are turned on a measured quantity of batter flows into the pan. At the end of an interval timed for proper cooking, the half-cooked pancake is deposited on its opposite side, on another cooking plate. When the pancake is completely cooked, the second plate flips it into a dish, ready to be carried away to the diner's table



The motor driven apparatus at the top pours batter into pan, turns cake, and removes it.

DESIGNS NEW BRACKET FOR WINDOW SHADES

This bracket holds the spear end of a curtain roller so that it cannot come out accidentally

Two small openings shaped like markings on cards of the "heart" suit enable a new window shade roller bracket to be used at either end of the roller. The smaller of the openings holds the projections on the ends of the roller. These are passed through the jaws that connect the markings. Putting up shades on these brackets is said to be easier than when one closed-jaw bracket is used to hold the "free" end of the roller.

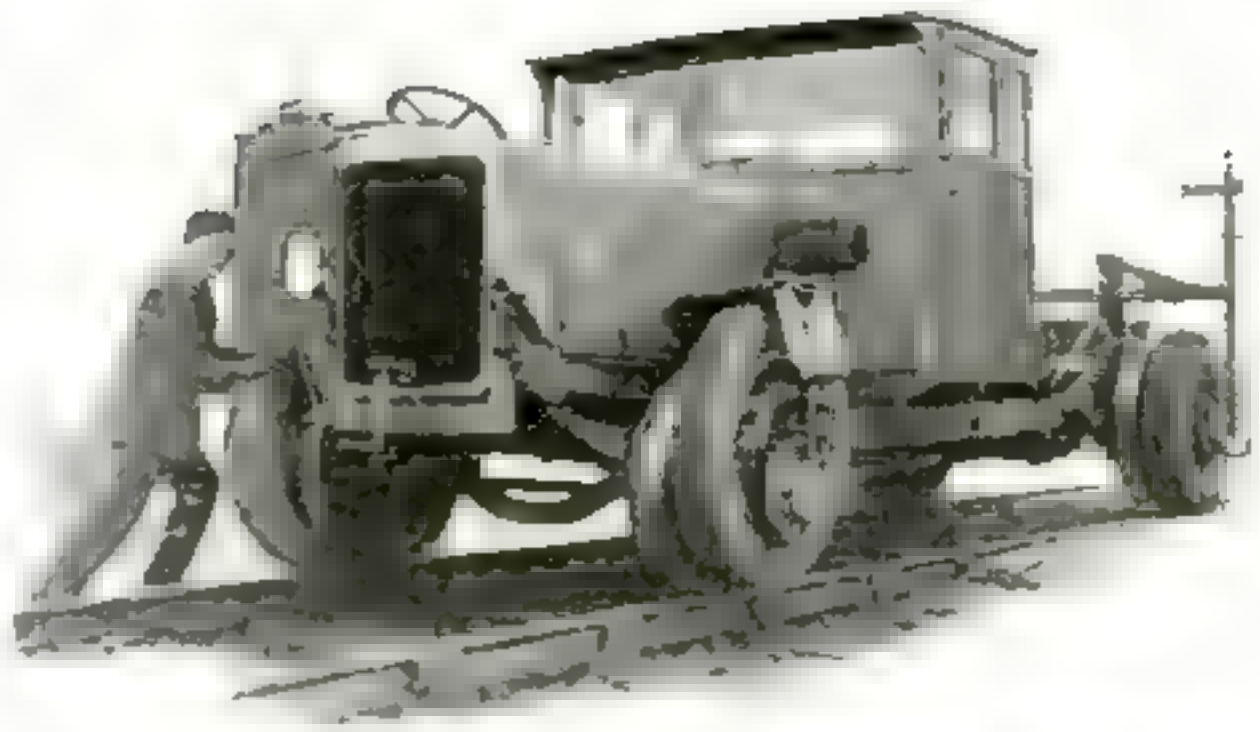
According to the inventor the bracket can be used with any type roller.

RED SQUILL RAT POISON WON'T HURT CHILDREN

Fatal to rats or mice, but harmless to humans and cats and dogs, a new rat poison was developed recently by the United States Department of Agriculture. It is made by grinding bulbs of the red squill, an onionlike ornamental plant found along the shores of the Mediterranean. The bulbs are sliced and dried in ovens before being ground into a fine powder.

This is mixed with fish, meat, or corn meal in order to attract the attention of hungry rats or mice foraging for a free meal. The proportion is an ounce of the powder to a pound of fish or meat. This new rat poison can be purchased at almost any drug store.

The powder is packed in air-tight containers, as exposure to the air before it is mixed with fish or hamburger steak robs it of its toxic property. Shielded from the air, the powder will retain its poison for an indefinite length of time.



STREET OR RAIL CAR CARRIES FREIGHT

Last month a British passenger vehicle that can travel on road or rails, known as the "Ro-Railer," was described in Popular Science Monthly. So successful were the first tests of this extraordinary gasoline motor car that a new type, the Freight Ro-Railer," has now appeared. Later may come double-deck passenger ro-railers.

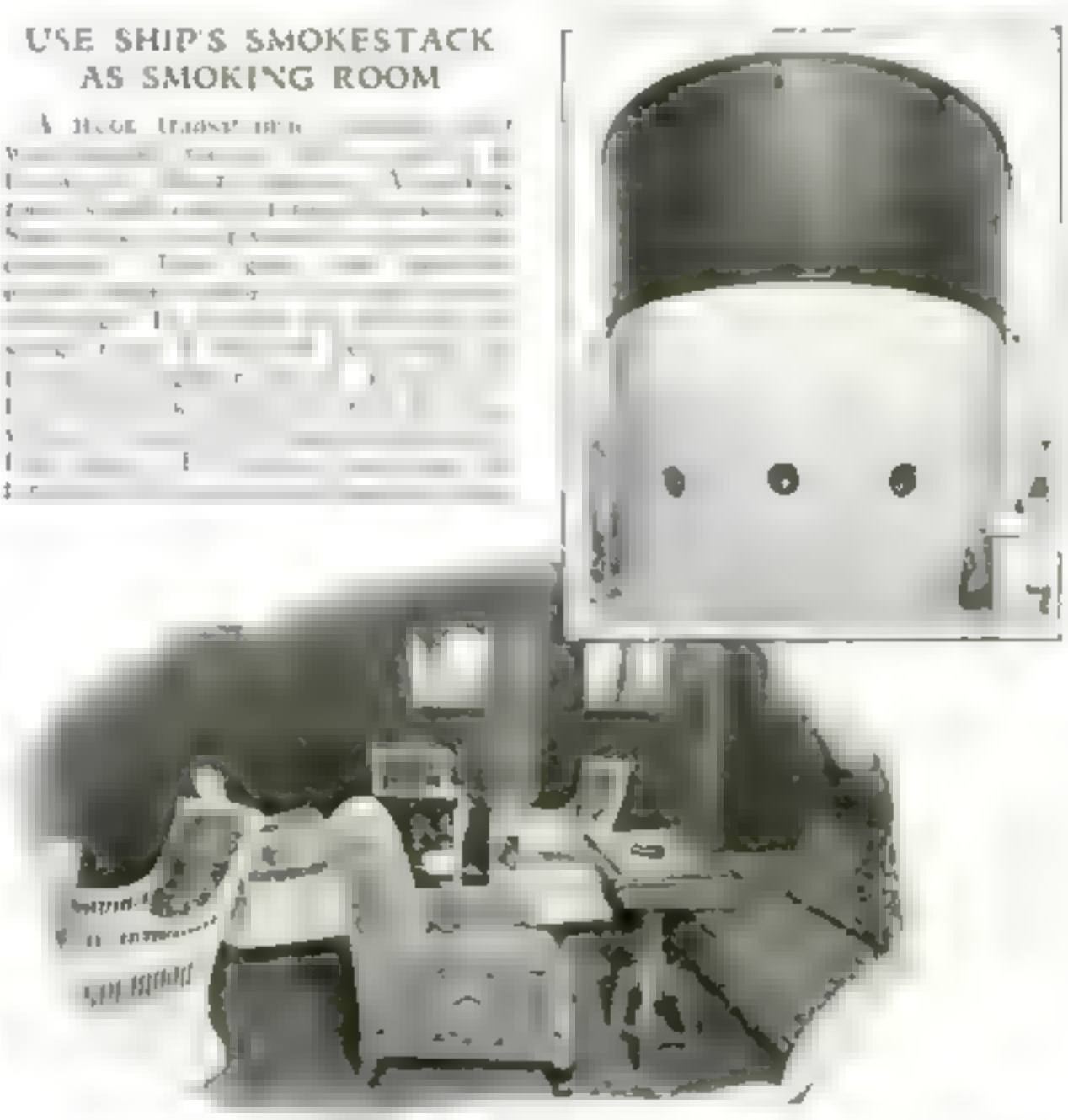
Passenger ro-railers can call for commuters at their doorsteps, mount the rails and ride to the city and deliver the passengers at their places of business. The same principle applied to freight vehicles cuts out the reloading between mine, quarry, lumber mill, or factory and the place of delivery.

The new freight ro-railer is designed to carry three tons of freight. One of the first uses suggested for it is in railway repair work. After hauling men and material to the proper point it can leave the rails, thus getting out of the way of through traffic.

Six months of tests are planned for the ro-railers by the London, Midland, and Scottish Railway. If successful, they will be placed in service on branch lines.

USE SHIP'S SMOKESTACK AS SMOKING ROOM

From bulbs of this red squill, an onionlike plant, is made a rat poison harmless to men,



At upper right is an exterior view of a dummy smokestack on a motor ship, inside which has been built the comfortable smoking room for engineer officers seen directly above.

TYPEWRITER HAS FOUR-FOOT CARRIAGE

How would you like to use a typewriter like this one every day? Said to be the largest in the world, it was not designed for correspondence. It was developed to handle forms and wide ledgers required by some steamship and insurance companies.

Its keyboard, which is usual size, is worked with no more effort than those of ordinary machines, although its forty-seven-inch carriage requires a little more [illegible] machine is more than three times the width of the ordinary machine and has a writing space of forty-four inches. This means that a desk sweep of about seven feet is [illegible]

NOSE HANGAR KEEPS PLANE FROM FREEZING

[illegible] which protect airplane [illegible] from subzero weather have been [illegible] Canada. Stoves in the [illegible] heated air around the motors [illegible] om freezing. Folding wings [illegible] able it to tuck its nose [illegible] Many Arctic explorers have [illegible] an oil stove to keep

In Canada, where zero weather is not unusual, this nose hangar keeps plane's engine warm.

ARMY AIDS "FLYING WEATHER" FORECASTS

Lieutenant Christy Mathewson, son of the famous baseball pitcher, is an Army aviator at Mitchel Field.

Within the last few months, "flying weather" predictions have appeared in newspapers. Where they come from is shown in this picture, made at Mitchel Field, N. Y. Here and at other fields, small balloons are released periodically. Observers watch their drift with theodolites, or measuring telescopes, to find the velocity of high-altitude winds.

The observer in the photograph is Lieut. Christy Mathewson, Army Air Corps—son and namesake of the famous baseball pitcher. Instead of baseballs, his hand releases balloons.

WAR-TIME DEVICE TO SAVE MINERS

A device developed in the World War to detect enemy tunneling or "sapping" may safeguard coal miners from one of their strangest hazards.

Occasionally underground pockets of gas, compressed under high pressure and tightly sealed by Nature, are found near coal mines. If an unlucky miner punctures one of these pockets, it explodes with a giant pop like that of a bottle of soda water. According to G. S. Rice, chief engineer of the U. S. Bureau of Mines, the war-time "geophone" to reveal tunneling may be used to warn of these extremely dangerous pockets in the solid coal.

NEWARK AIRPORT LEADS ALL OTHERS IN TRAFFIC

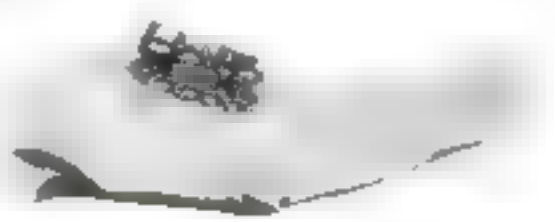
The airport at Newark, N. J., terminus of transcontinental air routes and hub of coastal air lines in the East, is now the busiest in the world. Fifty passenger planes, each bearing six to eighteen passengers, land or take off each day, and twelve mail planes arrive or leave nightly.

Chicago, former record holder, comes next, with a traffic of thirty-eight mail and passenger planes a day. Los Angeles ranks third. The air traffic of these cities exceeds that of London, Paris, and Berlin.

ONE-OUNCE LOCOMOTIVE SMALLEST IN WORLD

A one-ounce locomotive recently shown in London seems to justify its builder's assertion that it is the smallest one in the world. Leonard Beal, a musician of Hampstead, England, built the tiny locomotive.

Though but two inches long, it is an exact miniature of a light side-tank locomotive, a type used for short suburban runs in Great Britain. It uses pinheads for buffers. The model is driven by an electric motor that runs at 3,000 revolutions a minute.



Complete in every detail and run by electricity, this locomotive is claimed as world's smallest.

NEW HOOD AIDS PILOT IN BLIND FLYING

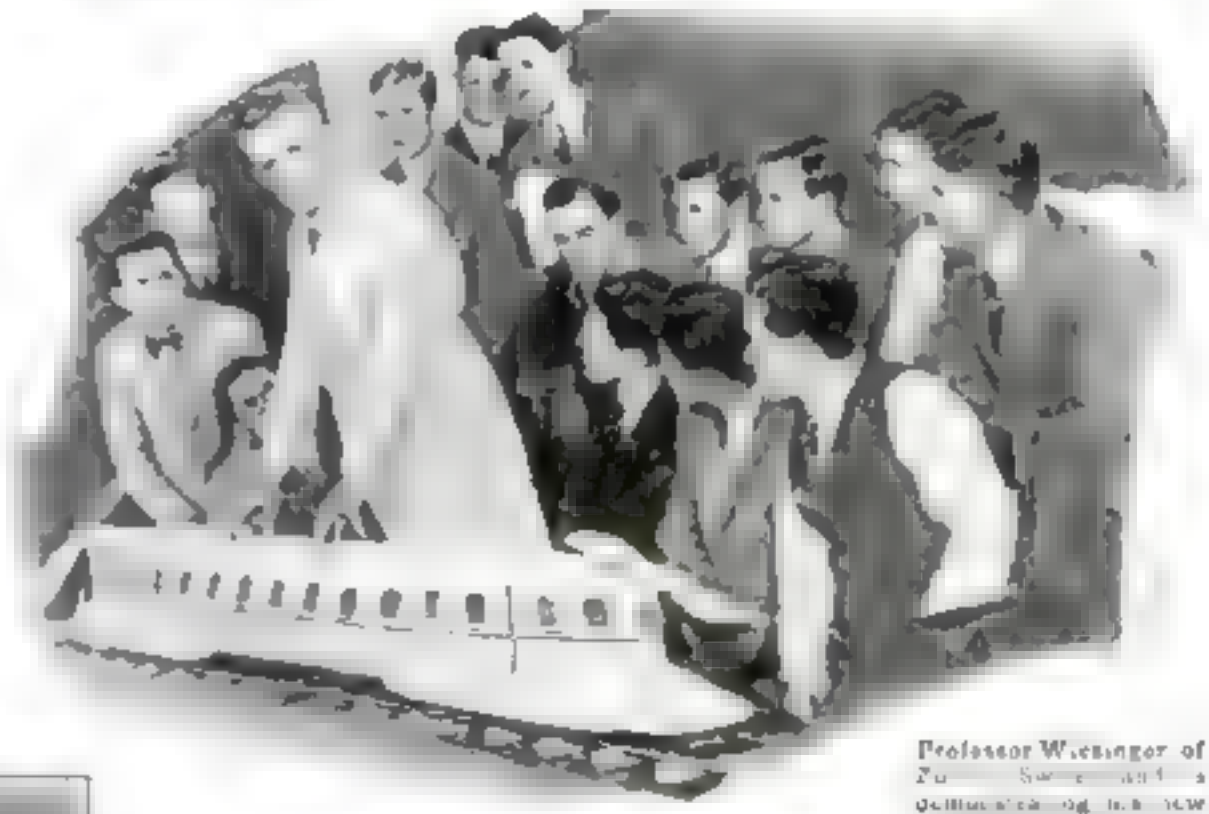
DANGERS of blind, or instrument, flying experiments are eliminated by a new type of hood, just constructed by two Brooks Field, Texas, engineers. It snaps open at the release of a trigger, enabling the flyer to climb out and free himself in his parachute in the event of a fall.

The new hood, for use in training in flying by instruments, is light and streamlined, and does not obscure the vision of the relief pilot in the rear cockpit. It is made of fine steel tubing and canvas, opens in the middle, and snaps down to the sides instantly. Blind flying hoods were formerly snap-down canvases something like the rain curtains of touring cars. In case of a plunge, the flyer was trapped in.

The photo below shows half of the hood open and fastened to the cockpit side thus illustrating its operation

A new hood that snaps open at the release of a trigger makes blind flying experiments safer

AIR-DRIVEN RAILWAY CAR FASTEST YET



Professor Wiesinger of Zurich, Switzerland, and a colleague standing in the new streamlined railway car

A RAILWAY car designed by Professor Wiesinger head of a technical school in Zurich, Switzerland, is believed to be capable of speeds of 225 miles an hour in daily operation with 150 passengers. The designer constructed a small scale model of his unusual looking vehicle, fully streamlined and fitted with aerial propellers at each end. Before an interested assemblage of students the little car its propellers flashing buzzed around the track at it is said, phenomenal speeds

A special railway is being built near Zurich so Professor Wiesinger can experiment with a full-sized car under actual operating conditions. This car resembles a German air-propelled railway car which attained a speed of 114 miles an hour in recent tests (P.S.M., Jan. '31, p.31)

FIRST FLORISTS' CLASS

WHAT is said to be the first school for florists as a part of a public school system is in operation in St. Louis Mo. Classes are held two evenings a week and students are taught designing, window trimming, and color harmony.

TYPEWRITER COUNTS WORDS AS WRITTEN

Now you can tell the length of a story or letter as you type it. A little device that counts words written by typewriters is the product of a firm of instrument makers in Hartford, Conn. It is operated from the space bar. Every time you depress it after writing a word, the device tallies up a word for you. Any one of several makes of standard typewriters can be fitted with this counter, which registers words just as the odometer of a motor car counts the miles passed on a trip. This device may be reset at zero when starting a new job or fresh day's work. Journalists and others who have found it necessary to make an accurate count of words doubtless will welcome this easily installed automatic tally device.

This word counter is attached to the space bar of a typewriter and keeps accurate count of words typed.

OFFICE BUILDING HAS GLASS WALLS

WITH outer walls made almost entirely of glass and steel, this office building represents a new trend in architecture. Windows are set in light steel frames and extend from floor to ceiling. Since the framework has been reduced to a minimum, the effect is that of an almost solid glass wall. The steelwork is covered with glistening aluminum paint, with the rivets plainly visible.

This building is occupied by the executives offices of a steel firm in Worcester, Mass.

STEAM HEAT AIDS BRIDGE BUILDERS

BUILDING a concrete bridge in winter was the problem that highway engineers of Lansing, Mich., recently faced. They solved it by constructing a steam-heated house over the entire length of the bridge site. This enabled them to pour concrete in weather that was frequently below zero. Accidents delayed them, so this work had to be done in winter.

With light steel frames and windows from floor to ceiling in each story this looks like a glass building.

The Architect Builds His Own Home—A Series

Simplicity *Adds Beauty* to House

By GEORGE WILLIAM TEARE

This homelike view was taken from the dining room looking through entrance hall into living room. At top, living room fireplace with large mirror and matching brackets.

IT SEEMS [illegible]

There was one important problem that I did not have to solve—that of selecting a site. A plot of ground, part of a [illegible] to the appearance of the structure, and increases the simplicity of two bay windows on the first floor by removing the

necessity of a roof for each of them

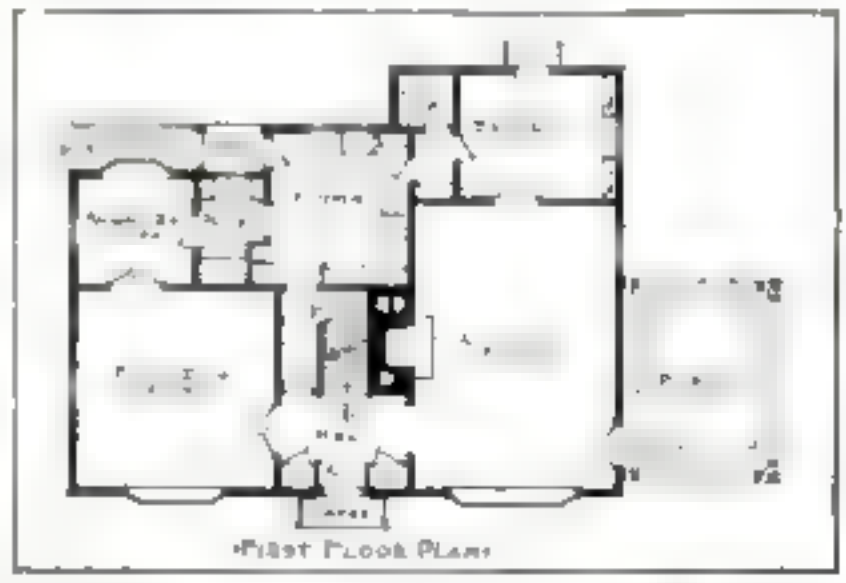
With the exception of the main entrance and north porch, the only external trim is the moldings beneath the eaves at the front and rear and beneath the second-story overhang. At each end, the roof has the appearance of being trimmed off flush with the outside walls. In fact, the roof shingles, of stained wood, project about one half inch over the painted wood shingles that cover the outside. Incidentally, the shingles on vertical surfaces are staggered slightly, so that the monotony of a great many straight, parallel lines is relieved.

ALL of the windows are of the multi-paned type, and are of generous size. They are provided with solid-paneled green shutters held back by S-shaped, wrought-iron dogs. Over the front entrance is a wrought iron lantern and bracket, and at each side are railings of the same material

At the rear are an iron railing and gate about the outside basement entrance, and wrought-iron railings flanking a rear door that leads into the book room or study. This ironwork adds to the general beauty by breaking up the lines and by providing contrast with the white exterior

I might say, without exaggeration, that I built the house around the chimney. This chimney is in the center and is large in size—the interior containing separate flues for an incinerator, a fireplace in the basement recreation room, another in the living room, and the vacuum-vapor heating plant.

Interior doorways on the first floor are arranged so that, if you were to place a compass with one point approximately in the center of the chimney, you could describe a circle that would pass through almost all of them. In addition, there is a narrow passage from the rear to the front hall, so that anyone in the kitchen can admit callers at the front door without entering the dining room


First Floor Plan

The front door opens into a vestibule or small hallway and is flanked on either side by clothes closets, one for guests and one for the family. To the left, a doorway that can be closed by curtained glass doors leads into the dining room. To the right, the living room is reached through an arched opening. Directly in front the stairway rises to the second floor, and the small front-to-back hallway is at the left of this.

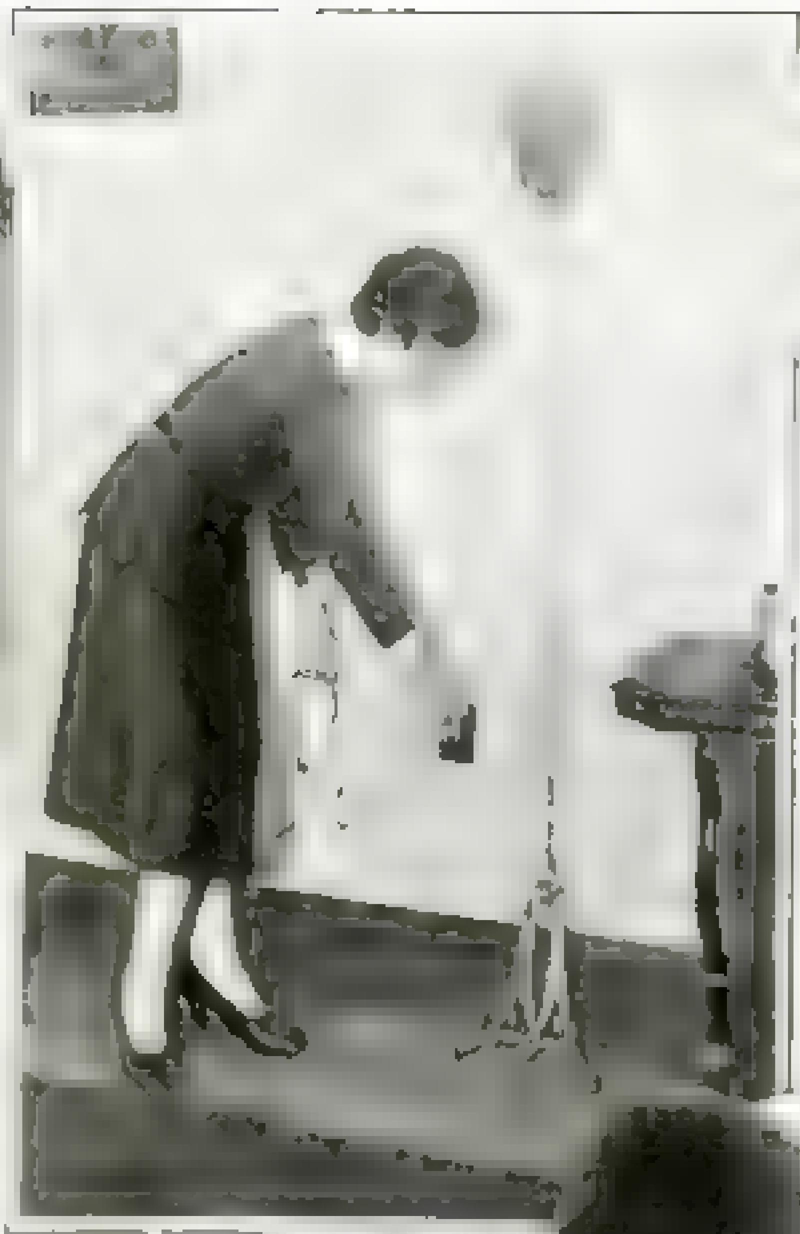
This view of the book room in the Teare home shows fine effect of the plain pine paneling

The two front bay windows, one in the dining room and the other in the living room, are unusual. I call them "picture windows" because, in the spring, the view of the blossom-laden orchard through them is superior to any painting I ever have seen. Another such picture window is to be found in the breakfast room that separates the dining room from the kitchen.

The front bay windows are large and are built up of twelve-by-fourteen-inch glass, five glasses wide and four high in the center section. This center is fixed, so that it cannot be opened. Ventilation is provided by the two side panels which can be swung outward. This arrangement reduces the size of the corner posts, adds to the simplicity of construction and maintenance, and provides adequate ventilation without excessive draft

Radiators are placed beneath each of the three bay windows in the house, and are covered by woven metal cane grilles set in wood frames, all of which are painted to match the woodwork in the rooms in which they are located.

I consider (Continued on page 136)

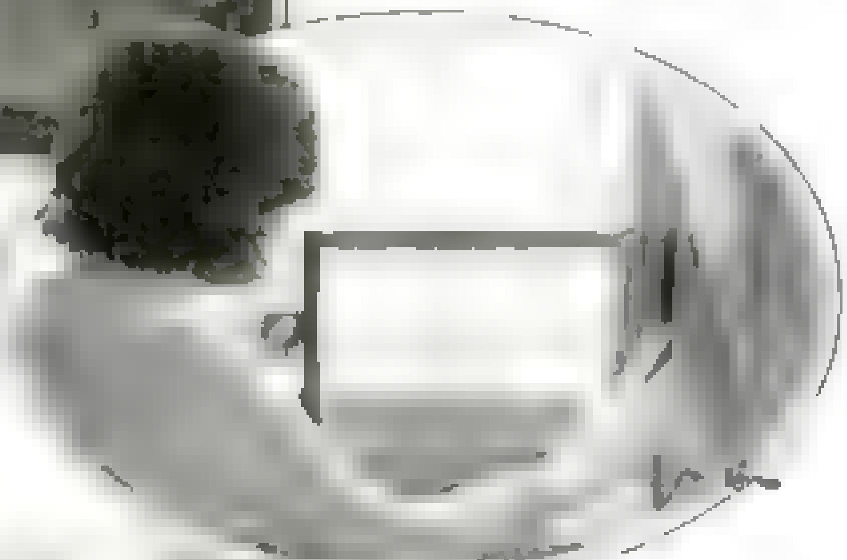


SCENT[illegible] ELECTRIC BULBS [illegible]

MOVABLE LIGHT FIXTURES [illegible]

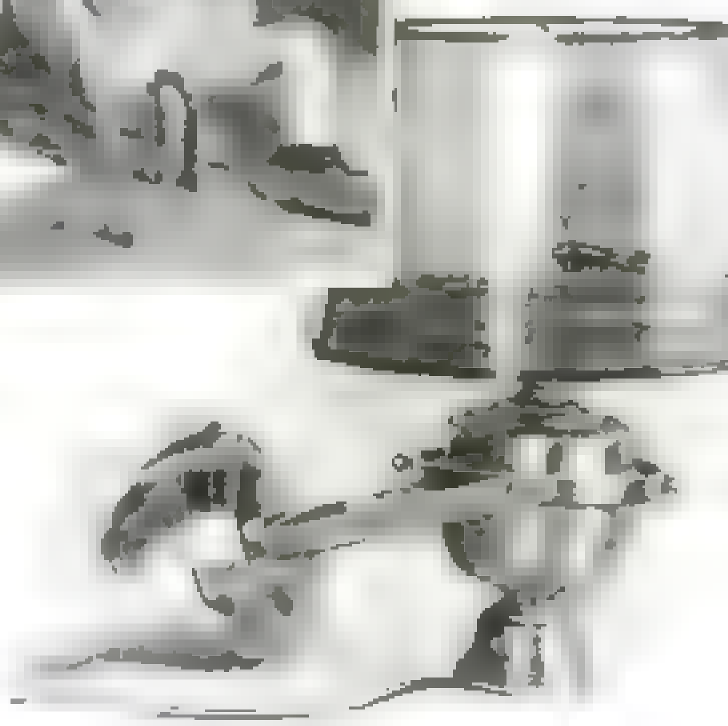
MOP THAT CAN'T MAR [illegible]

Novel Household Inventions



BUILT-IN ELECTRIC REGISTER [illegible]

THREE TOOLS IN ONE [illegible] handy in the k[illegible] caps can be quickly removed [illegible] and [illegible] can be used to seal the bottle and preserve contents. It is also fitted with a corkscrew so that everything that comes in bottles is readily accessible with the aid of this versatile tool

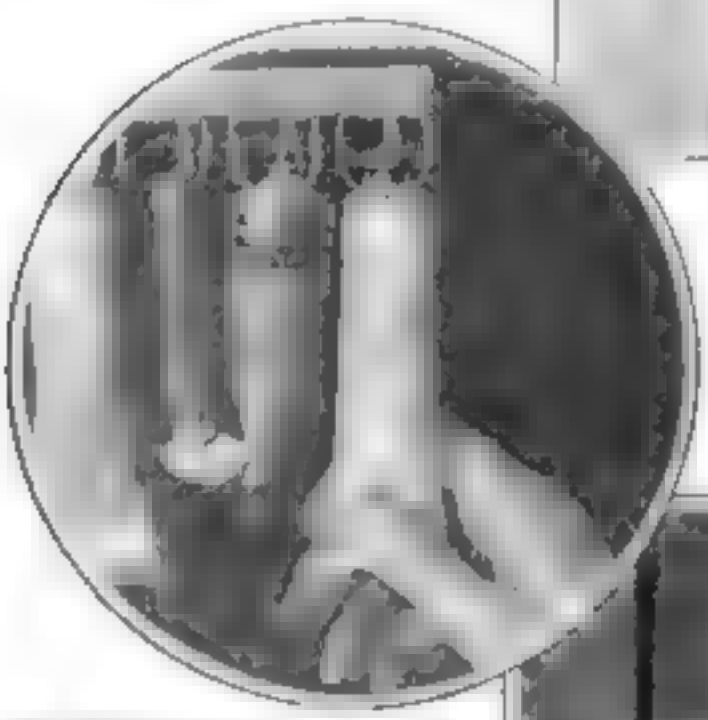


[illegible] OF TABLE LAMP [illegible] a permanent [illegible] With the base [illegible] the lamp it becomes a table light that stands firmly on a level surface.

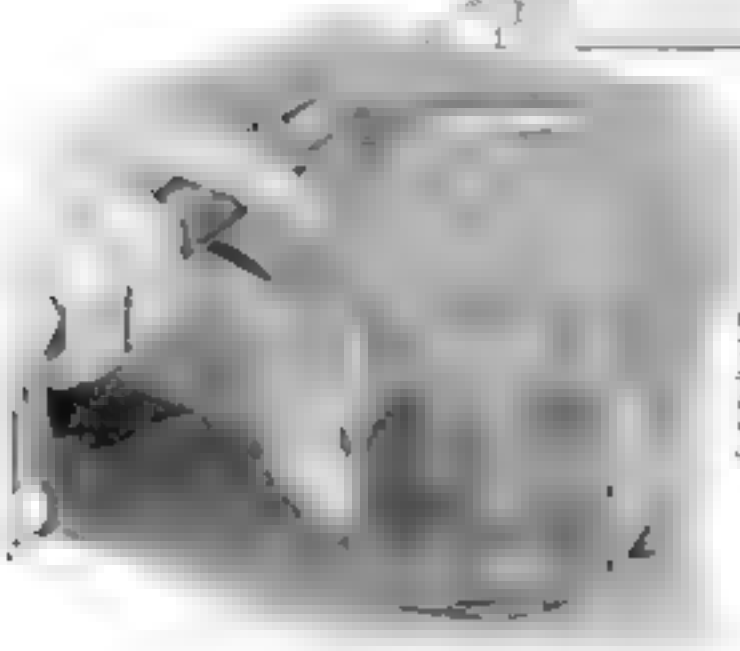
ANCHOR VOLTMONT P

ELECTRIC FOOD MIXER The

KEEPS AIR MOIST



CLOCK HELPS COOK A



JUST BY A CLOCK

NEW KIND OF ICE PICK

NONSKID BOTTLE. Wet milk bottles are hard to hold and consequently slide through the fingers to crash on the floor. The bottle at right has bumps blown in the neck to assure firm grip at all times.

POPULAR SCIENCE MONTHLY

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Radio Rackets

THE air is surcharged with hokum. The wonderful radio networks, described in these pages last month, are used by a small army of fakers as webs in which to catch the unwary. Nowadays, every receiving set is a trap for the gullible.

The turn of a knob, almost any hour of the day or night, will bring you the voice of an astrologer warning you not to get married while the moon is waning.

Another turn, and there is a graphologist, offering to read your character and tell your fortune from your handwriting.

A third twist, and a numerologist fills your living room with a lot of nonsense about "name vibrations." Turn the dial again, and a "psycho-analyst" gives advice on how to get along with your mother-in-law.

Here is a painful paradox. Radio, one of the greatest developments of modern science, is widely exploited to further pseudo-sciences either so old that they were discredited ages ago, or so new that real men of learning have not yet found time to expose them.

BUT that is not the worst of it. The long-suffering air is used by a growing number of quacks to advertise fake medicines and worthless mechanical appliances supposed to cure all sorts of diseases.

These charlatans are forbidden by law to hang out their shingles. Their advertisements are barred by every self-respecting newspaper and magazine. Now they have seized upon the radio to help peddle their nostrums for complaints ranging from cancer to chilblains. Where, in print, they used to talk to thousands, they now talk to millions. And where they duped hundreds, they now dope thousands.

For example, five stations in and near New York City broadcast "health talks" which in reality are advertisements for a solenoid—simply a coil of electric wire—that is supposed to affect the iron in the blood and cure high blood pressure and several other ailments.

An investigator, who recently visited the headquarters of a firm selling this device, found the office crowded with women. Most of them were poor, middle-aged, foreign, and of the uneducated type.

A strange phase of the situation is that the newspapers, which would not think of accepting paid advertising matter for such cure-alls, print announcements of the broadcasts, free of charge, as "science talks" or "health talks" in the radio programs they publish daily for the convenience of their readers.

This also holds good in the case of the fortune tellers, star gazers, mind readers, and "psychologists." Broadcasts by mountebanks who could not get their announcements into the better newspapers for any amount of money are listed gratis, in the radio columns.

For instance, the other day, in the radio column of a big New York newspaper, we found a feature listed as "Talk by a Psycho-Analyst." When we tuned it in, it turned out to be a spiel by a graphologist, soliciting letters from which to read character and tell the future. The same man, less than a year ago, used to practice mind-reading.

At this writing, there are more than a score of such impostors on the air in New York City and its immediate vicinity alone. Their talks are put on the air in three different ways. The big stations offer them either as sponsored or sustaining features.

A sponsored program is one paid for by an advertiser. A man, for example, has stockings to sell. To attract the attention of possible women customers, he puts a fortune teller on the air. A sustaining feature is one paid for by the broadcasting company itself.

The third method is that used by the smaller stations. They sell time on the air direct to the fakers, who use it to work their "come-on" schemes at the expense of the ignorant and gullible among radio listeners.

No matter by what means they get on the air, the talks of all the charlatans are offered under the guise of entertainment. In reality, they are nothing of the sort. They are the old confidence games palmed off on the public in a new way. They are radio rackets.

THE fakers, of course, are pretty sharp fellows. They well know that fortune telling, for instance, is against the law in many states. But they don't tell fortunes. They merely give "lectures." Letters received from their listeners are answered with offers of a book. There's no law against selling books.

They solicit no money on the air. But hundreds of listeners, of their own free will, enclose from one to five dollars with their written requests for advice. There is no law against either giving or receiving gifts of money. Nor is it illegal to sell such articles as a coil of wire to anyone gullible enough to buy them.

Not long ago, investigation showed that a New York astrologer has a "trade" of some 2,000 customers, mostly radio listeners. Their letters are not even read. They are asked to write the month of their birth at the top of the paper. A staff of secretaries simply stick a printed card for the victim's birth month in an envelope and mail it out in return for one dollar.

The same sort of swindle is rampant on the Pacific Coast. Unfortunately, there is no law forbidding a fraud to sell a piece of worthless paper for a dollar.

WHAT is the remedy? Many thousands of letters from persons swindled by radio racketeers have been received by the Federal Radio Commission in Washington. But the Commission, under the law, does not have the right to censor radio programs.

It has, however, the power to refuse renewal of a license to stations broadcasting matter that is not in the public interest. Recently, the Commission used that right. It canceled the license of a Kansas physician who conducted a questionable "radio clinic" from a station of his own. The doctor appealed in the courts, but the Commission was upheld.

This decision means that the Radio Commission, from now on, can proceed against all stations that broadcast programs clashing with public health or safety. But it is extremely difficult to prove that the talks of astrologers, crystal gazers, and manufacturers of cure-alls do any such thing.

Thus, the only way to clear the air of all such rubbish is for the stations themselves to clean house. This magazine is a proven friend of radio. It was one of the first publications in this country to publish a special radio department. It has no quarrel with any broadcasting company. The contrary is true.

Because it is a friend of radio, POPULAR SCIENCE MONTHLY urges the stations to throw the rackets off the air. Only by so doing will they escape a rigid censorship that is sure to come if they continue to place their facilities at the disposal of unscrupulous charlatans who victimize the public.

HELPFUL HINTS FOR RADIO FANS

Tiny Condenser for Set Builder

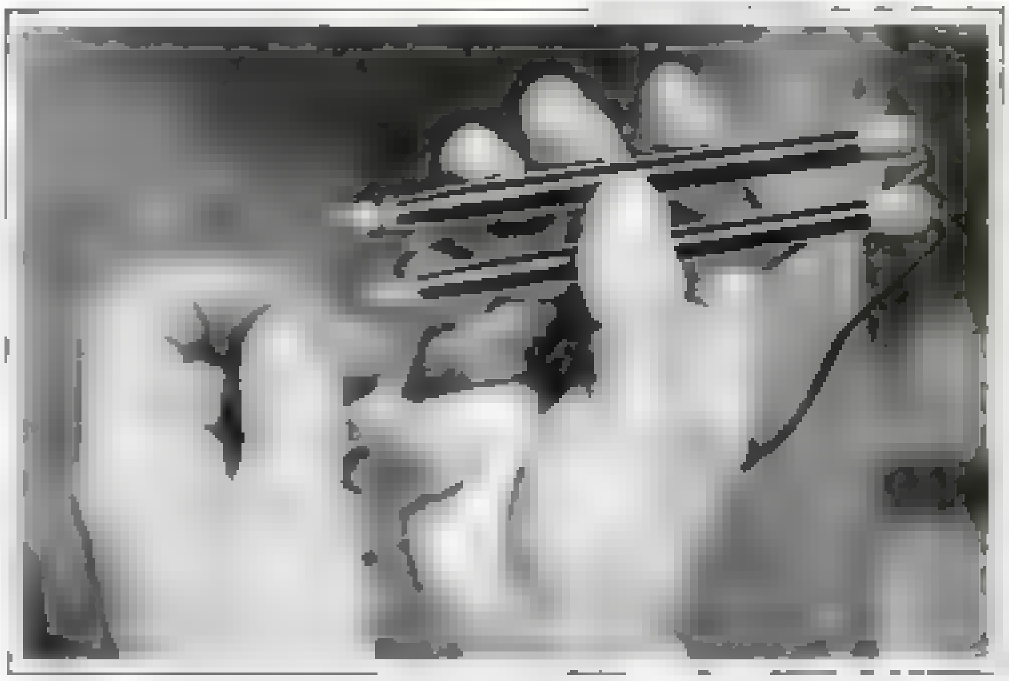


Fig. 1. Test points fitted with a phonograph needle are used in testing to insure good contact with parts of electrical circuit

IN BUILDING any type of portable radio receiver, the limiting factor is the size of the individual parts. Fortunately tuning coils can be wound of fine wire on small diameter coil forms without seriously impairing their efficiency.

Putting the tuning condensers into a small space is not so easy. In order to cover the broadcast band of frequencies, the maximum capacity of the condenser cannot be reduced and formerly condensers having sufficient capacity in extra small size were not to be had.

Figure 2 shows a new type of "grown-up" midget condenser that is only a trifle larger than the usual midget unit sold for vernier tuning. By close spacing of the plates and careful design, this new unit has been made to a capacity suitable for tuning the full broadcast band with the ordinary tuning coil.

When space is available for the full sized condenser, it is better to use it rather than the small one shown because the latter is of the straight line capacity type and consequently will crowd the stations at the lower end of the dial. But when space is vital, the new type will save a lot of it.

NEW TEST POINTS

A VERY large part of radio testing and trouble shooting is in determining the electrical difference between two parts of the circuit. When you measure the electrical voltage at any point in the circuit you are finding the difference in electrical pressure between two points. When you determine value of a resistance you are finding out how much electrical resistance there is between two points.

The problem of obtaining a good electrical contact with the two parts of the circuit, without at the same time getting an electric shock, usually is solved by the use of insulated test points on the ends of flexible wires. Pieces of metal rod or bus wire serve as emergency test points if nothing better is available.

Figure 1 shows a novel type of test point fitted with a tiny chuck which holds a phonograph needle. The needle, being sharp, can be pushed through the insulation on insulated wires in order to get contact with the metal conductor inside and the hole it makes is so small as not to damage the insulation. Moreover, the sharp steel point penetrates corrosion or the hardened remains of soldering flux on exposed terminals.

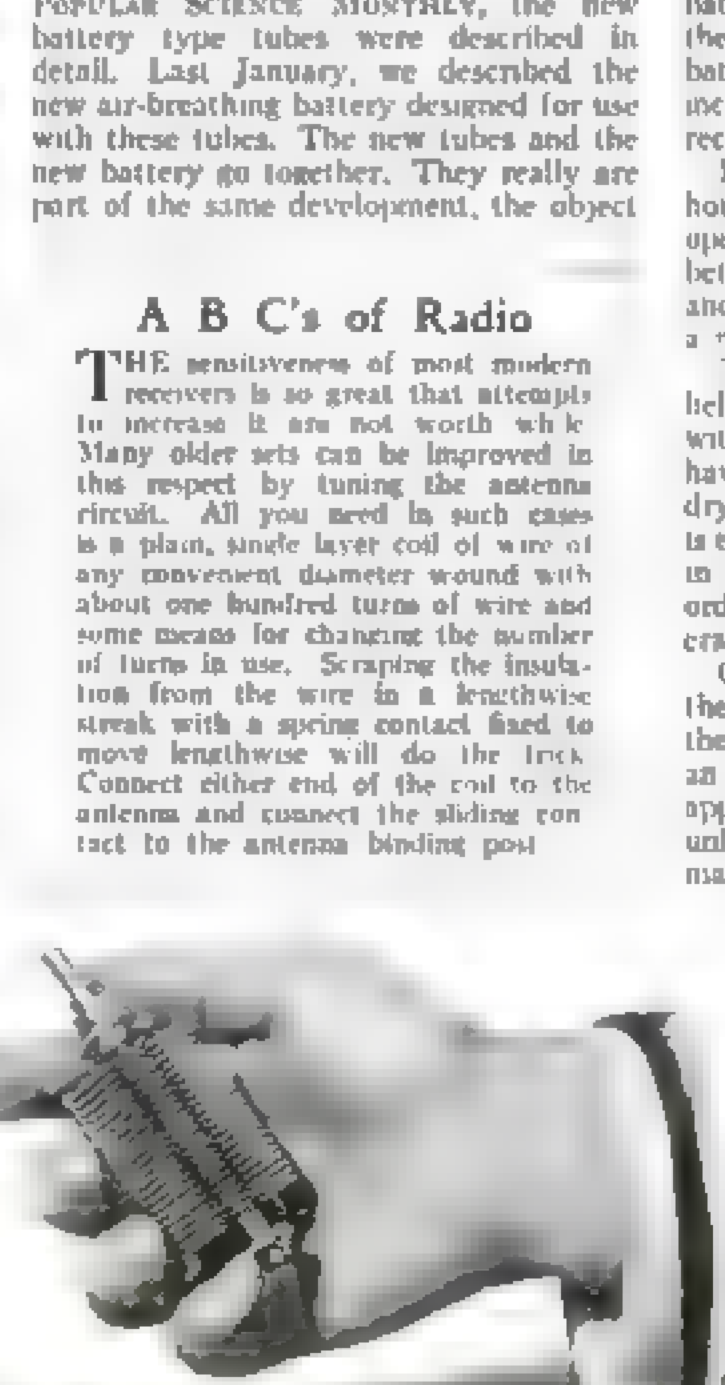


Fig. 2. This grown-up midget condenser is suitable for tuning the broadcast frequency band

USE OF BATTERY TUBES

IN THE October, 1930, number of POPULAR SCIENCE MONTHLY, the new battery type tubes were described in detail. Last January, we described the new air-breathing battery designed for use with these tubes. The new tubes and the new battery go together. They really are part of the same development, the object of which is to give better and more economical radio reception to people living where no electric light current is available.

Although the article on the new tubes gave their electrical characteristics and definitely stated they gave a performance equal to the storage battery tubes types 201A, 112A, and 171A, many people still have the impression that they are better than the tubes used in storage battery operated sets. That is not true.

If the filament current for your set is supplied from a storage battery and you have adequate means of keeping the battery charged, the new tubes are of no interest to you. Of course if there is no electric light current in your home and you have to transport the heavy storage battery to a place where it can be charged, then the use of the new tubes and the new battery will save you a lot of trouble and inconvenience and still give you as good reception as you now obtain.

If electric current is available in your house and you are still using a battery operated set, then the logical way to get better reception and get rid of the trouble and inconvenience of batteries is to buy a modern electric set.

This all means that the new tubes will help you only if you are using a set fitted with type 199 tubes or equivalent and you have to supply the filament current from dry cells. Changing over to the new tubes is easy if you built the set yourself because in that case it is most likely to be of the ordinary tuned radio-frequency or regenerative variety or perhaps a neutrodyne.

Old commercial or home-built sets of the reflex type do not work so well with the new tubes. There is, in many cases, an undue tendency to squeal. This also applies to factory built superheterodynes unless the conversion is made by a service man who is familiar with the peculiarities of the particular circuit.

A B C's of Radio

THE sensitiveness of most modern receivers is so great that attempts to increase it are not worth while. Many older sets can be improved in this respect by tuning the antenna circuit. All you need in such cases is a plain, single layer coil of wire of any convenient diameter wound with about one hundred turns of wire and some means for changing the number of turns in use. Scraping the insulation from the wire in a lengthwise streak with a spring contact fixed to move lengthwise will do the trick. Connect either end of the coil to the antenna and connect the sliding contact to the antenna binding post.

HEAT AND TROUBLE

WHEREVER an electric current flows, heat is produced because of the electrical resistance of the circuit. If some part of your radio set gets hot it is not necessarily a sign of trouble. The power transformer usually runs at a temperature about as hot as your bare hand will stand.

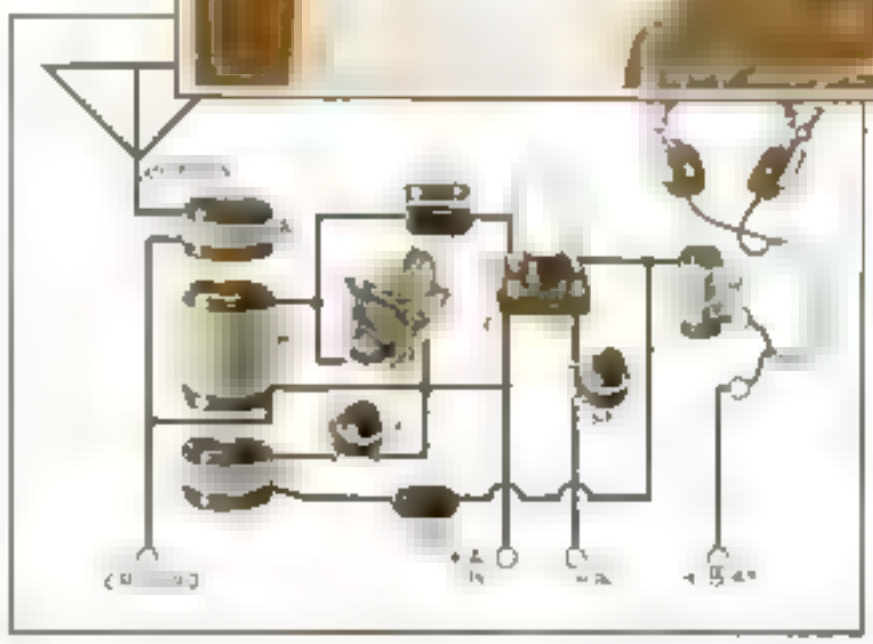
Resistances in the power network often get hot enough to fry eggs after several hours' run. To make these parts run cooler, it would be necessary to build them two or three times their present size.

Radio's Mystery Waves Explained

Special Apparatus Needed if You Want to Hear Short Wave Vibrations that Carry Long Distance Broadcasts

By ALFRED P. LANE

Pope Pius XI [illegible] the wheel that [illegible] by opened [illegible]



IN THE average radio fan's mind the [illegible] "short wave radio" conjure up thoughts of unbelievably long distance reception, queer apparatus, and unusual complications. An atmosphere of mystery surrounds the whole subject.

As a matter of fact short wave transmission is just one branch of radio and is no more complicated or difficult to understand than ordinary broadcasting. Of course there are some short wave phenomena that do not appear to jibe with the rules generally accepted by radio experts, but then, nobody can be sure that the rules are right!

Short wave radio differs from ordinary broadcasting only in the frequency of the wave. The short wave oscillates or vibrates more rapidly. Assuming that visible light and audible sound are comparable to regular broadcasting, short waves occupy the same relative position as sound vibrations so rapid that they cannot be heard or light waves that cannot be seen because they have a frequency beyond the violet end of the spectrum. That is the essential feature of short wave radio—the use of extremely rapid electrical vibrations.

YOU wouldn't expect to produce the sound of a piccolo from a bull fiddle or ultra-violet light from a red-hot poker. Similarly, while the theory of short wave radio is the same as that of ordinary broadcasting, the transmission and reception of the higher frequency require modifications in the size and arrangement of the apparatus.

Broadcasting ordinarily is conducted with frequencies that range all the way from 550,000 cycles per second up to 1,500,000 cycles per second. Radio transmission on any frequency more rapid than this is called short wave radio. At present radio transmission is regularly being carried on at frequencies up to 14,000,000 cycles per second and experimental work is being carried on at frequencies much higher than this, sometimes ranging as high as 400,000,000 cycles per second.

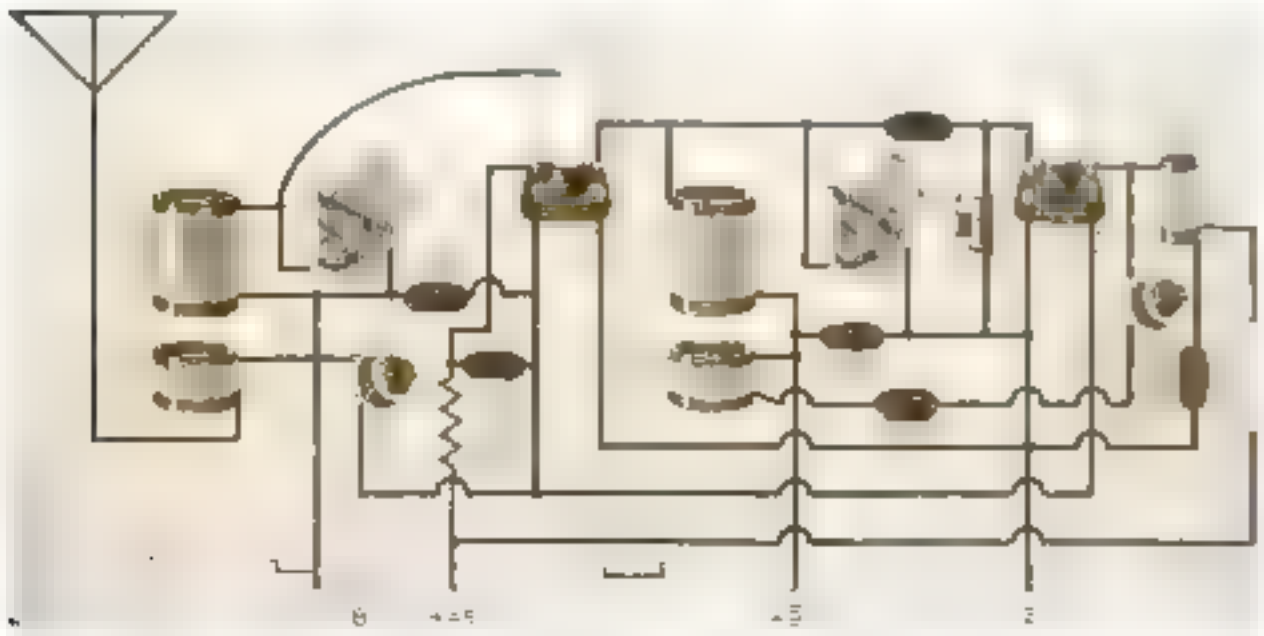


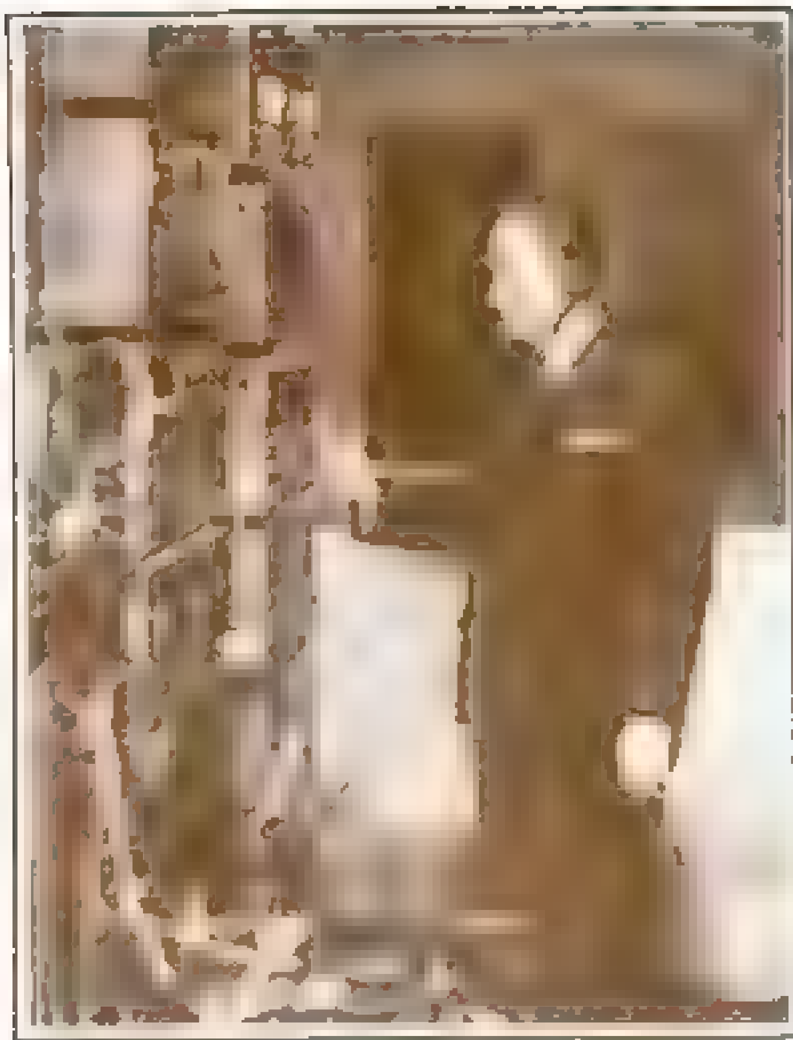
Fig. 3. This is a diagram of the two-tube circuit revised so that the coupling tube gives useful radio-frequency amplification. If frame of *D* touches shield, do not connect shields together.

Most radio communication on these high frequencies is in code, and consequently is of no interest to the radio program fan. However, a number of broadcasting stations in this country and in Europe transmit regular broadcast programs on the high frequencies and there are also amateur telephone transmission on two bands of short waves, commercial transatlantic telephony, and other phone work such as between airplane fields.

In theory at least, all of this transmission can be picked up by the radio fan in his own home if he has the proper equipment. In practice he may or he may not be able to get adequate short wave reception. A lot depends on his location and on his skill in using his apparatus.

THE basis of any radio transmitting or receiving outfit is the tuned circuit. Your broadcast receiver probably has several of these tuned circuits. Each of the variable condensers connected to the shaft leading from the dial is wired to a coil and constitutes, with it, a tuned circuit.

There is no theoretical difference between a tuned circuit for broadcast reception and one designed to bring in the short waves. Each has electrical capacity in the form of a variable condenser and electrical inductance in the



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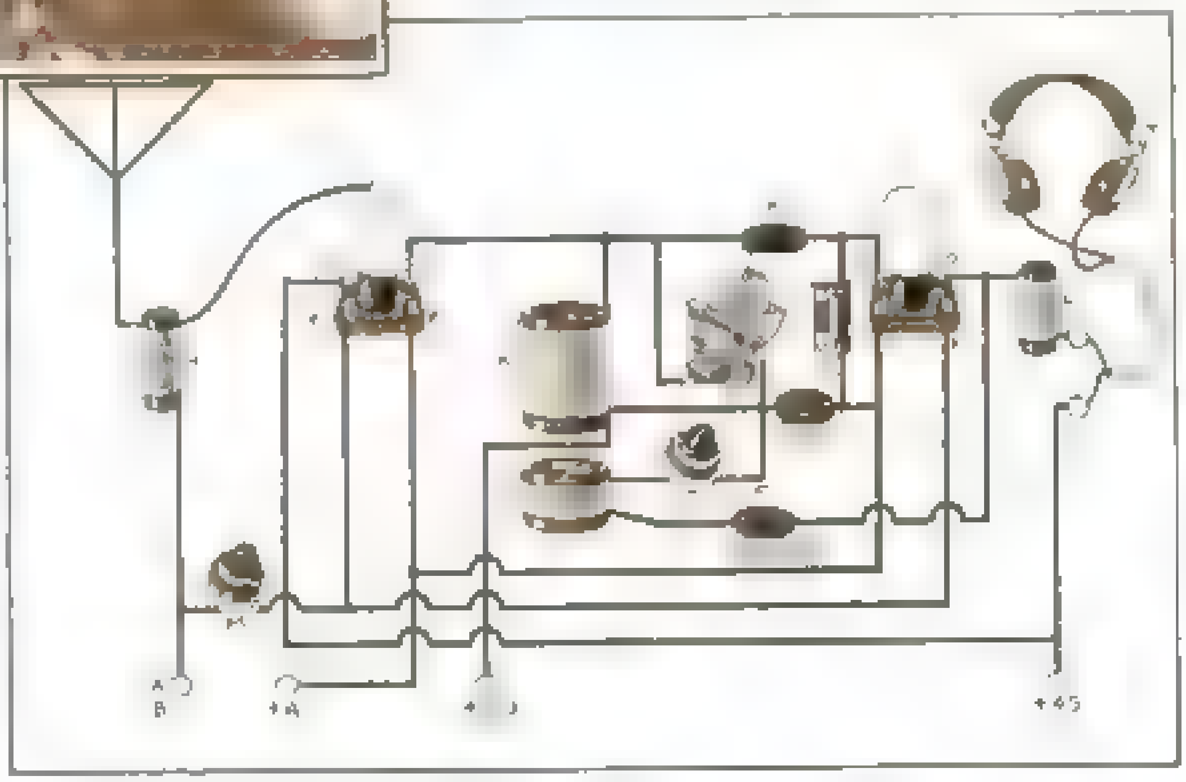


Fig. 2. Diagram of a set designed to pick up short wave broadcasts. Note ... [illegible]

form of a coil of wire. By making the capacity variable, the circuit can be tuned to the different frequencies within its range.

The same result could, of course, be obtained by using a fixed capacity and tuning by changing the number of turns of wire in the coil. Changing the capacity is, however, more practical and mechanically convenient.

THE rule is that increasing either the number of turns in the coil or the capacity of the condenser lowers the frequency to which the circuit will respond. Naturally the rule works both ways; so to tune a higher frequency, you must reduce the number of turns of wire or the capacity of the condenser.

Many radio fans, knowing these simple relations, have wondered why a broadcast receiver could not be converted into a short wave set merely by substituting coils with fewer turns of wire and smaller condensers. In theory the idea is sound. In practice it doesn't work for several reasons, among them the fact that the radio receiver and its associated apparatus is far from theoretically perfect.

The perfect radio receiver would be one in which all of the inductance concentrated in the tuning coils and all of the capacity in the tuning condensers. However, there always is stray inductance and capacity in the wiring, shielding, and other metallic parts of the set. Also, the tubes themselves have a certain irreducible minimum capacity.

These small stray capacities are of relatively little importance in tuning the broadcast waves, but when [illegible] to cut down the [illegible] and capacity to tune the short waves with their much higher frequencies, the stray capacity effects become mountains instead of molehills.

FOR a mechanical parallel, suppose you had an automobile with leaky carburetor throttle shaft. The small amount of air that got in around the shaft wouldn't make any particular difference when you were rolling along at high speed or climbing a heavy grade with the throttle wide open. But if you tried to let the motor idle slowly it probably would stop altogether because the air leaking in around the throttle shaft would form such a large proportion of the total as to spoil the mixture.

That is why radio receiver construction good enough for broadcast reception will not work on the higher frequencies.

Short wave radio reception is fascinating because it varies so remarkably. You may, for example, almost wear the knurling off the dial knob in an unsuccessful attempt to get a short wave broadcasting station only a few hundred miles away, and the same night you may hear a foreign station with considerable volume.

THE next night, and perhaps for months thereafter, you may never hear a peep [illegible] foreign station although you may at times, hear many other distant [illegible]

Another interesting peculiarity that short waves display is the "skip-distance" effect. It is often found that a receiver located only a few miles from the short wave station may not hear it at all, while another receiver a couple of hundred miles away is rattling the loudspeaker on the same station.

Then, still farther away, there may be an area where no signals are heard and beyond that the signals may literally come to earth again and be heard for thousands of miles. Furthermore, there are daily and seasonal changes in the performance of any particular frequency. Some frequencies carry better in daytime than at night. Others are good only at night.

The carrying powers of the different short waves in daylight and dark also seem to be subject to a slow change that appears to coincide with the increase and decrease in the number of spots on the sun. The sunspot cycle of eleven years from maximum number of spots to minimum and back to maximum again causes a change in atmospheric conditions that affects radio transmission.

It is, however, too early to determine the general effect of the eleven-year sun spot cycle because high frequency, short wave radio has only been in use for seven or eight years.

Considering the vagaries of short waves and the steady excellence of ordinary broadcasts, it (Continued on page 135)

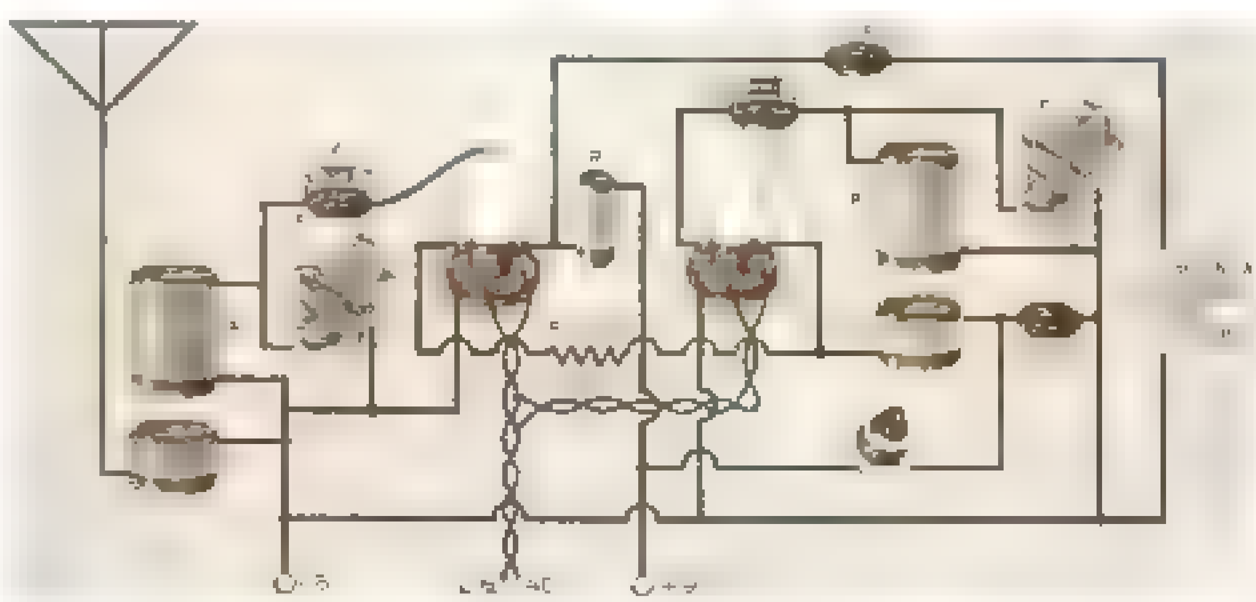
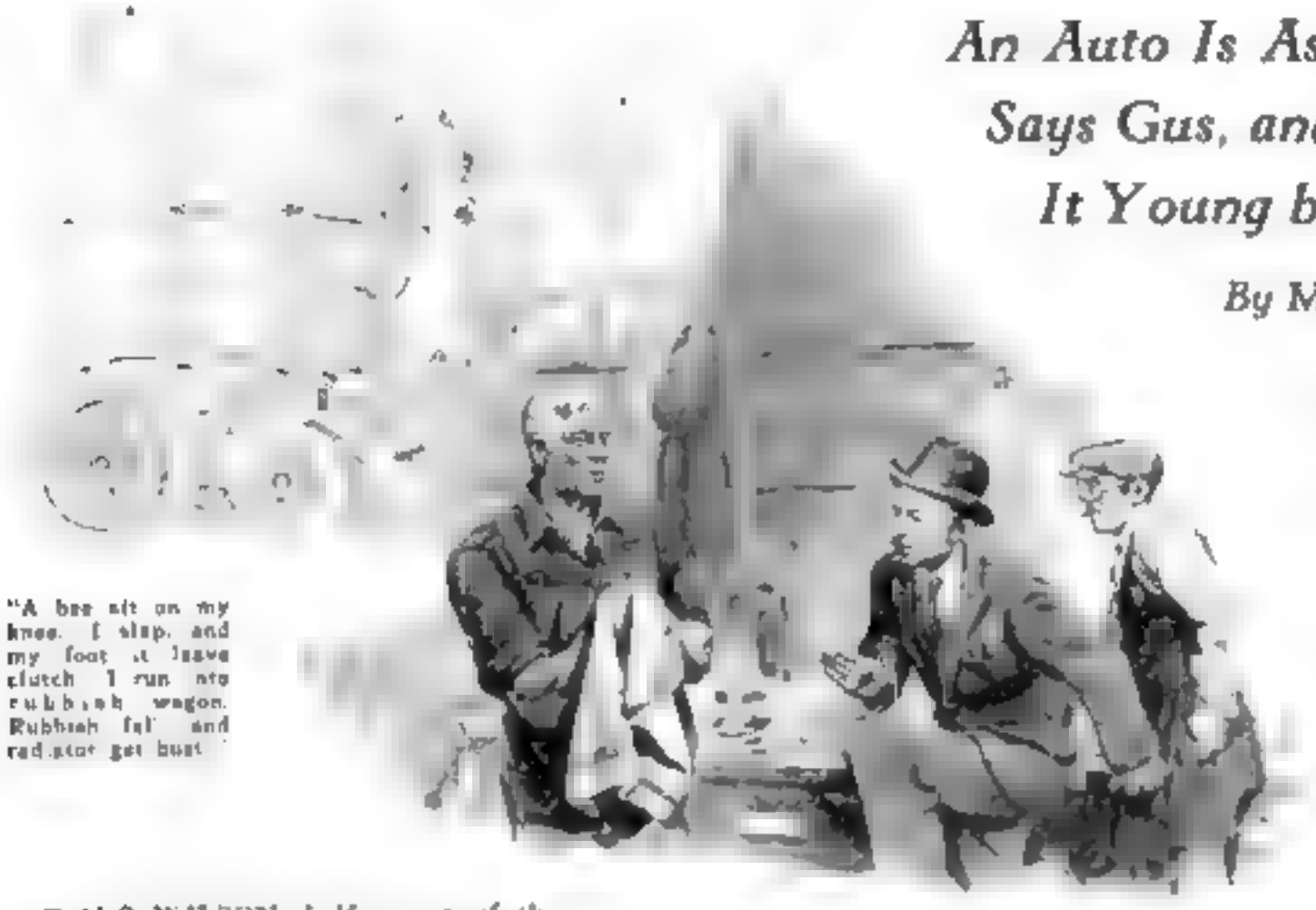


Fig. 4. This diagram shows a detector-oscillator hook-up to be connected to the antenna and ground binding posts of a broadcast receiver to make a short-wave superheterodyne.

Should Law Scrap Old Cars?

An Auto Is As Old As It Acts, Says Gus, and You Can Keep It Young by Proper Repairs

By MARTIN BUNN



"A bee sit on my knee. I slap, and my foot it leave clutch. I run into rubbish wagon. Rubbish fall and radiator get bust"

GUS WILSON, half owner of the Model Garage had about decided to call it a day when his partner Joe Clark called him to the window.

"What the idea of the funny decorations?" Joe asked, pointing to a small sedan that was coming slowly down the road. The car certainly looked queer. Scraps of paper and strings of various colors fluttered in the breeze, a sheet of brown paper was wrapped around the front axle, and the remains of a burlap bag dragged from the rear bumper.

Gus gazed at it wonderingly, but before he had time to make a reply the car swung in and came to a bucking halt in front of the garage. Immediately there came a loud hissing sound, clouds of steam poured out of the openings in the hood and a torrent of steaming water rained down and formed a pool under the motor.

The two garage men came out in time to see the owner pop out of the car and shake his fist at the offending radiator.

"*Sacre!*" he yelled. "After all these mile' I have driven you, little pig, you try to push the van full of the rubbish from the road—and see what happen! Jules Marceau, he punish you!" And he backed up his threat with a vigorous kick administered to the unoffending front tire.

Gus calmed the excited little man and led him into the office. "Tell us what happened, Mr. Marceau," he suggested.

"Perhaps it is a little bit my fault," Marceau began, his wrath rapidly evaporating. "I take Marie to the shops this afternoon and I wait for the traffic light behind a grand big truck filled with bags of the rubbish. A bee jump through the window and he sit on my knee. I slap, and my foot it leave—how you call, the clutch—and my car it jump right into the rubbish wagon. The rubbish it come down all over me and the radiator get bust'. Is it not what you call bad luck?"

Gus grinned. "Bad luck and poor management," he observed. "If you hadn't had the car in gear, you could have taken a poke at the bee without having your car jump ahead."

"Of course, lots of drivers put the gears in first speed when they stop in traffic and keep their feet on the clutch pedals waiting for the signal to go ahead. But you shouldn't do that. Anything that happens to make you move suddenly—like the bee that landed on your knee or maybe a hot cigar ash falling on your hand or even a little cramp in your leg muscle—is going to make you take your foot off the clutch pedal and slam into whatever is ahead of you. You're lucky you weren't at the head of the line with a lot of people walking across the street a foot or two from your bumper. You might have killed somebody.

"Besides," he continued, "you're putting a lot of extra work on the clutch throwout bearing when you stand in first gear with the clutch pedal down."

"But I do not stand in the first gear," Marceau protested. "I am such a good driver I do not need the first speed. Me, always I start in the middle speed."

"Humph!" the veteran auto mechanic grunted. "If you start in second all the time, I'll bet your clutch lining is pretty near worn out already. Starting in second is bum dope unless you have a four-speed transmission with first geared so low that it isn't any use. Let's take a look at that car."

They pushed it inside and Gus investigated the extent of the damage.

"Not so bad," he said. "For a wonder the radiator isn't damaged. I'll fix the supports and put on a new hose connection and it'll be all right except for that dent in the hood. I'll pull that out, too, if you'll bring it in tomorrow."

As with every car that came into the place, Gus inspected it to see if any vital part was out of order. He poked at the brake pedal, thumbed the horn button, fingered a broken spot in the windshield wiper hose, and squinted at the wheel alignment.

"Looks to me like you had a few other little jobs here, Mr. Marceau," he said. "The brakes need taking up, the horn doesn't work, and the windshield wiper is out of commission."

"Pouf!" exclaimed Marceau waving his fingers expressively. "The brakes you should fix, yes, but these other little things are as nothing. I do not like the sound of the horn and never do I drive in the rain."

"Maybe so," Gus growled. "But if you ever meet an inspector he'll think different. Blowing a horn all the time is silly business but there's times when the horn may save some child's life or your own. As for the windshield wiper, you must be some weather prophet if you can be sure you're never going to be caught in a driving rainstorm at night!"

"I have not think of it so," said Marceau. "It is the one time in the thousand that the noise maker is necessary. That is true! Fix it at once! Never will I take the chance again. And the scrubber of the windshield also."

"That's the way to talk," said Gus with a smile. "With all the cars that are around today, everybody's got to keep his machine right or pretty soon there'll be a lot of new inspectors on the road just looking for *(Continued on page 178)*

Gus Says:

AN AUTOMOBILE wears out in two ways—there's the wear on the mechanical parts and the wear on the body upholstery, and paint. Age means nothing to the mechanical parts mileage wears out the motor and running gear. Age means more than mileage to the body, so if you expect to keep a car for several years and not drive it very much, it pays to put some extra dollars into a better body.

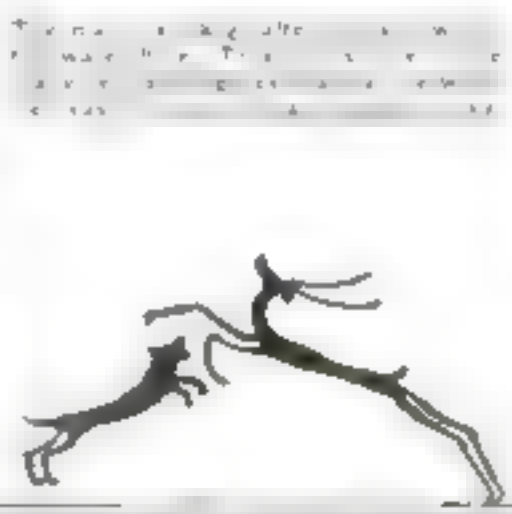
BETTER SHOP METHODS • NEW IDEAS FOR THE HANDY MAN • BLUEPRINTS

THE HOME WORKSHOP

MODEL MAKING • HOME WORKSHOP CHEMISTRY • THE SHIPSHAPE HOME

Prizes *for* Match Stick Models

Here is a brand-new and amusing pastime that you ll really enjoy—and a chance to win one of eighteen cash awards

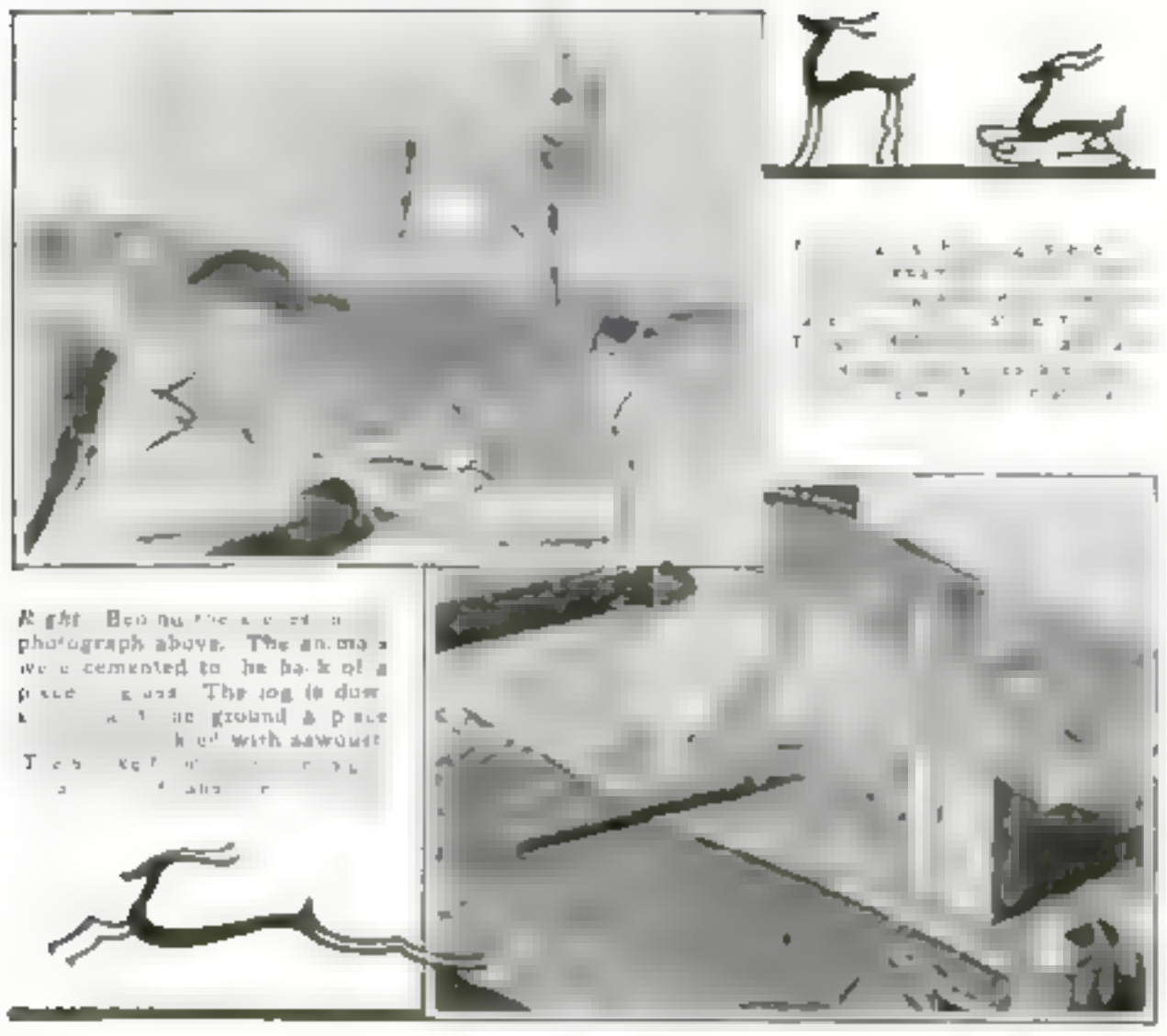


Three match stick nymphs dance in the moonlight. The beach is sawdust, the lake a piece of [illegible]s, and the moon the light of an electric lamp shining through a ho e in a cardboard sky.

W[illegible]

[illegible] anything simply send [illegible] Home Workshop Department the [illegible] tick figure you are able to make—[illegible]

[illegible] raphers. Those who wish to try for these two prizes will have to submit a photo-



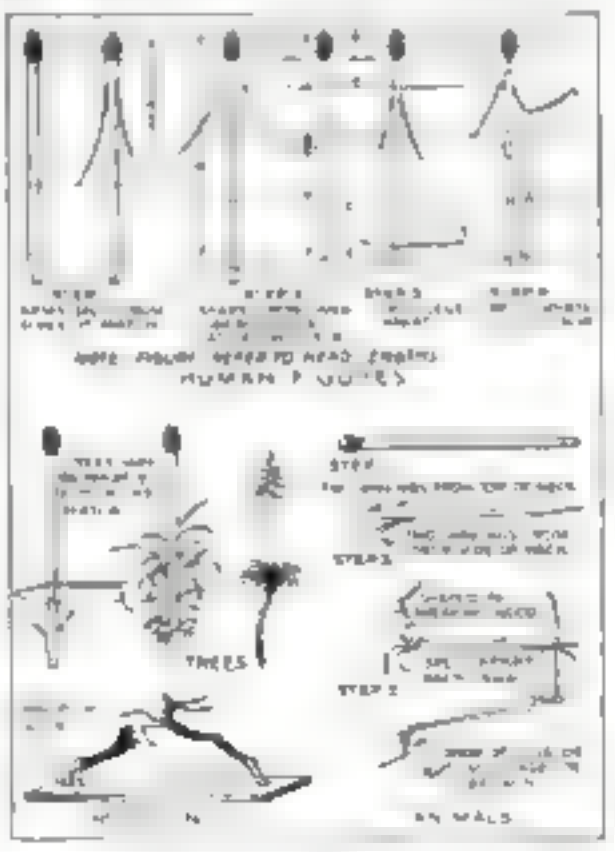
partment, who will be remembered by many readers for his remarkable series of articles on the construction of various types of "comiculls" in 1926 and 1927. The photographic arrangements of Mr. Hughes' ingenious match stick figures are by Frederick D. Ryder, Jr.

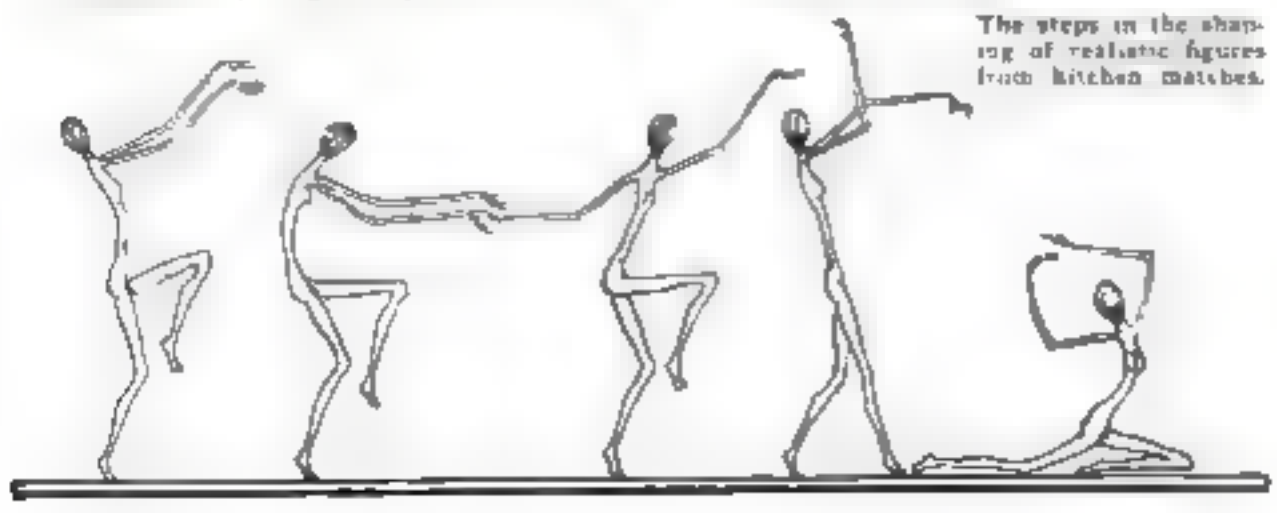
To make these dancing figures and animals, Mr. Hughes says, no special skill with tools is required. With a little care and patience it is simple and easy to develop novel and attractive models. Frequently the best figures are the result of more or less aimless or idle whittling.

The general principles of making human figures, animals, trees, and shrubbery from match sticks are shown in the accompanying drawings. Curves and angles are produced by cutting, bending, and breaking the wood as necessary. When breaks are made, a drop of glue or mucilage is applied to the joint and allowed to dry before the work is continued.

In the models illustrated, some attempt has been made to give them natural proportions. For example, the proportions of the human figures are approximately correct in comparison to the length of the head, which is the governing unit. It is not necessary, however, to make the figures so naturalistic or to develop them so elaborately. They can be made frankly comical, modernistic, or grotesque. The idea match stick figure, indeed, is one that conveys the most action and has the most character with the least change from the plain match stick form.

Among the subjects most suitable are sports of all kinds—baseball, football, skating, skiing, hunting, racing, bathing—and





The steps in the shaping of realistic figures from kitchen matches.

occupations that involve vigorous action.

A completed group may be preserved by gluing the figures on a small piece of stained wood or colored cardboard. The figures themselves should be left the natural color of the wood. A thin coat of clear, thin shellac, lacquer, or light oil may be applied, but nothing more.

$100 in Cash Prizes

FOR the best examples of match stick whittling received on or before June 1, 1931, POPULAR SCIENCE MONTHLY will award eighteen prizes as follows:

First prize	$25
Second prize	15
Third prize	10
Three prizes, $5 each	15
Ten prizes, $2 each	20
Special prize for best photographic arrangement	10
Second special prize for photographic arrangement	5
Total prizes	$100

The contest is open to all except employees of POPULAR SCIENCE MONTHLY. Each entry (except those for the special photographic prizes) is to be a human figure, animal, or other object or model made from a single wooden match stick of the common kitchen variety. You may enter as many match stick models as you wish, but not more than one prize will be awarded to any one contestant. In case of a tie, prizes of full value will be given to each tying contestant.

The entries will be judged on the basis of their (1) general effectiveness, (2) originality, (3) simplicity and economy of means by which the effect has been obtained, and (4) neatness of workmanship.

The figures should be mounted in such a way that they can be inspected easily by the judges, and they should be packed carefully to protect them from damage in shipment. Nothing can be added to the matches, and no modeling with wax or other compositions is allowable. The heads of the matches may be left on or removed, as preferred. If they are left on, they should be oiled, momentarily lighted, or otherwise treated to reduce the likelihood of their being ignited by friction.

Prizes for Photographs

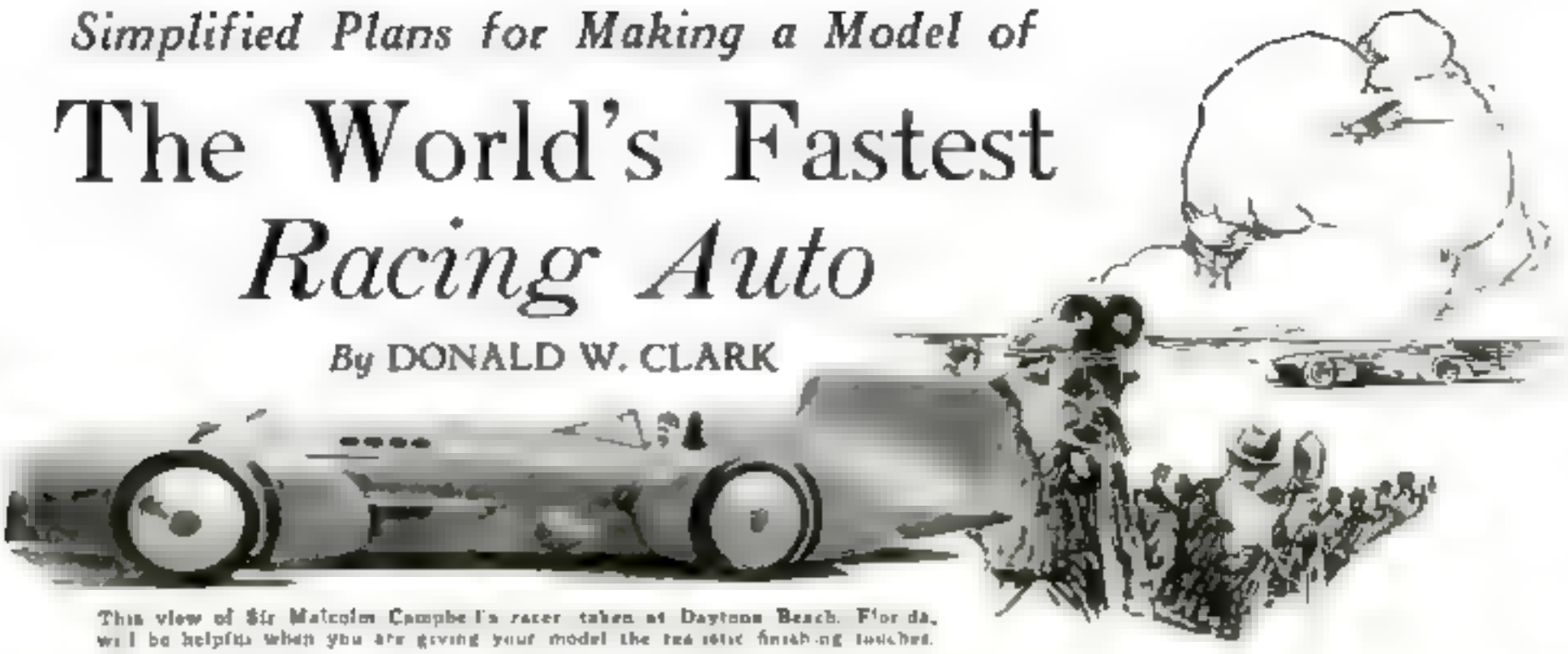
In the case of entries for the two special prizes for photographic arrangements, the general conditions are the same except that any number of match stick figures or other models up to six in a group may be submitted, and these must be accompanied by a photograph showing them arranged in an appropriate setting. Any desired accessories or lighting effects may be used in taking the photographs, and it is not necessary to send the accessories with the figures provided a brief written statement is made as to the materials of which the setting consists. The figures or other models accompanying each photographic entry will also be considered as individual entries in the main contest. Those who submit photographic arrangements will therefore have a chance to win one of the other prizes even if they fail in winning one of the two special prizes. They may also submit additional individual figures to be entered in the main contest, if they wish.

Address all packages to the Home Workshop Department, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, N. Y. Entries must reach this office not later than June 1, 1931. None of the models will be returned. The judges will be the technical and home workshop editors of POPULAR SCIENCE MONTHLY, whose decision will be final. The names of the prize winners will be announced as soon as possible after the close of the contest.

Simplified Plans for Making a Model of

The World's Fastest *Racing Auto*

By DONALD W. CLARK



This view of Sir Malcolm Campbell's racer taken at Daytona Beach, Florida, will be helpful when you are giving your model the realistic finishing touches.

BECAUSE of its extraordinary design and almost incredible speed, Sir Malcolm Campbell's latest streamlined racer *Bluebird II* is a timely and interesting subject for the model maker. Streaking across the smooth sand at Daytona Beach, Florida, this car recently attained a speed of 245 miles an hour, winning for Sir Malcolm the world's automobile speed record (P. S. M., Apr. '31, p. 32).

The smooth regular curves of the car's body and the lack of intricate visible details make it an easy model to build and if the simplified drawings given below are followed little difficulty should be encountered.

The arrow-shaped body of the racer is made up of two ½-in. pieces of white pine or whitewood. This is done for convenience of construction, as it is then possible to cut the recess for the cockpit and assemble the steering gear easily before the two halves are glued together. The slot for the ⅛ in. thick tail fin also can be cut beforehand, and the two body parts and the fin assembled in one operation. The shaping of the body can be done with a pocketknife, half-round files, and sandpaper.

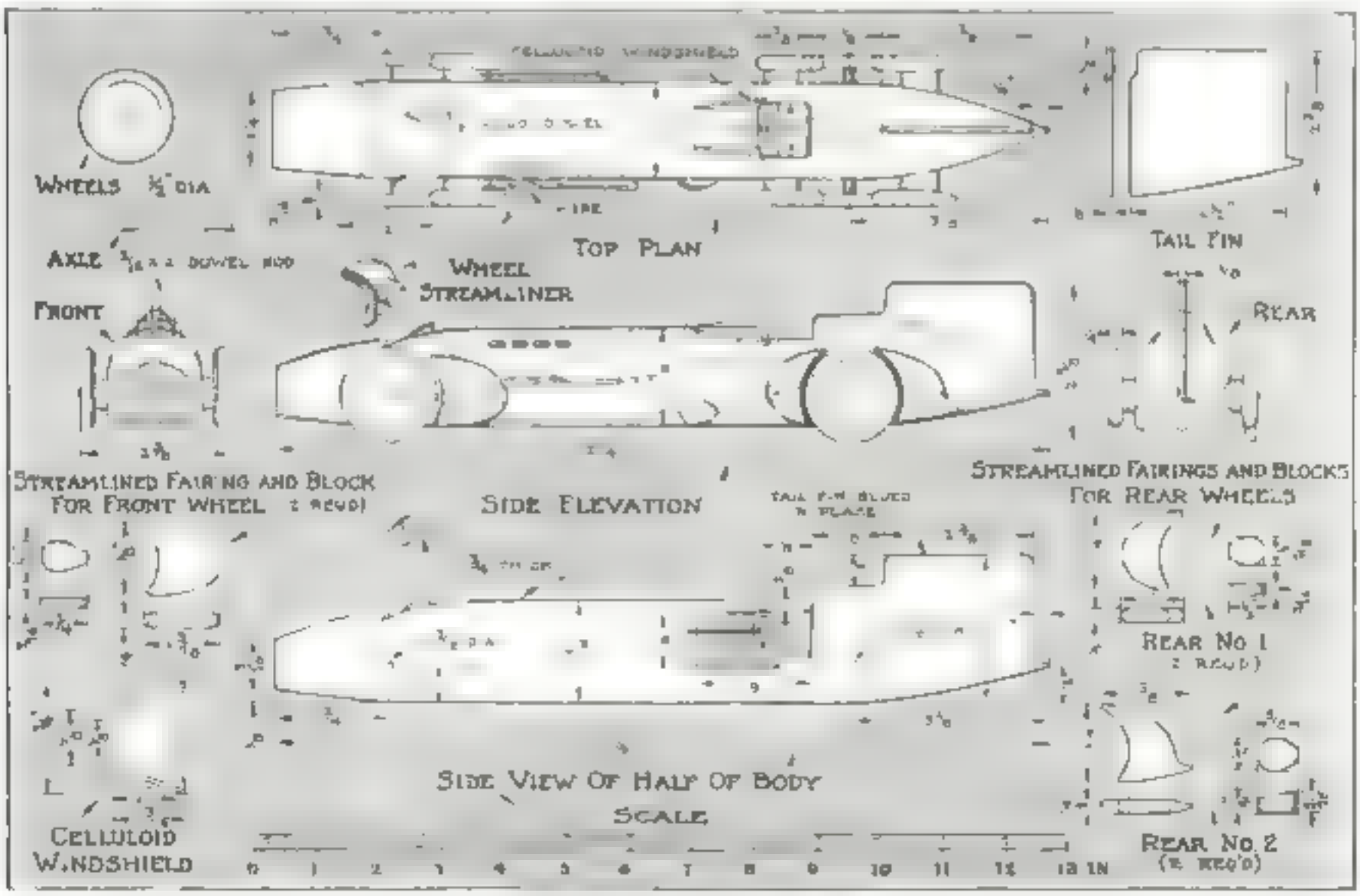
Softwood is also used for the streamlined pieces that go in front and in back of both rear wheels and in back of the front wheels. These fairing pieces are fastened to the body with nails driven through the streamlined spacer blocks.

Two 2-in. lengths of 3/16 in. diameter dowel rods are set in holes in the body to form the axles. The wheels are fastened to the ends of these axles with small nails driven through thin washers. If some discarded toy will yield four metal wheels 1½ in. in diameter, they may be used instead of wheels made from wood.

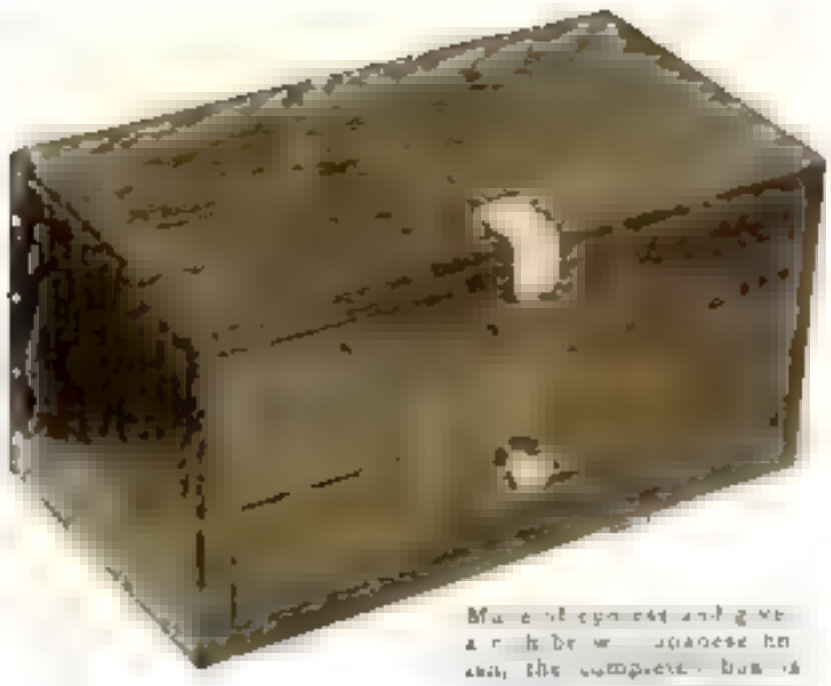
Over the top of the cockpit is a celluloid windshield, held in place with brads.

The body is colored dark blue, the disk wheel coverings are aluminum, and the tires black. On the front of the nose piece or radiator are the American and British flags crossed (the British flag to the right), and on each side of the tail fin is a smaller British flag—all painted, of course, in their natural colors.

The *Bluebird II*, ready to drive, weighs 2½ tons, and the engine is capable of developing 1,450 H. P.



Top, side, front, and rear views of the assembled model, a fully dimensioned side view of the body, which is composed of two similar parts, each ½ in. thick, in order to make it easier to cut the cockpit recess and install the steering gear; and details of the fin and other parts.

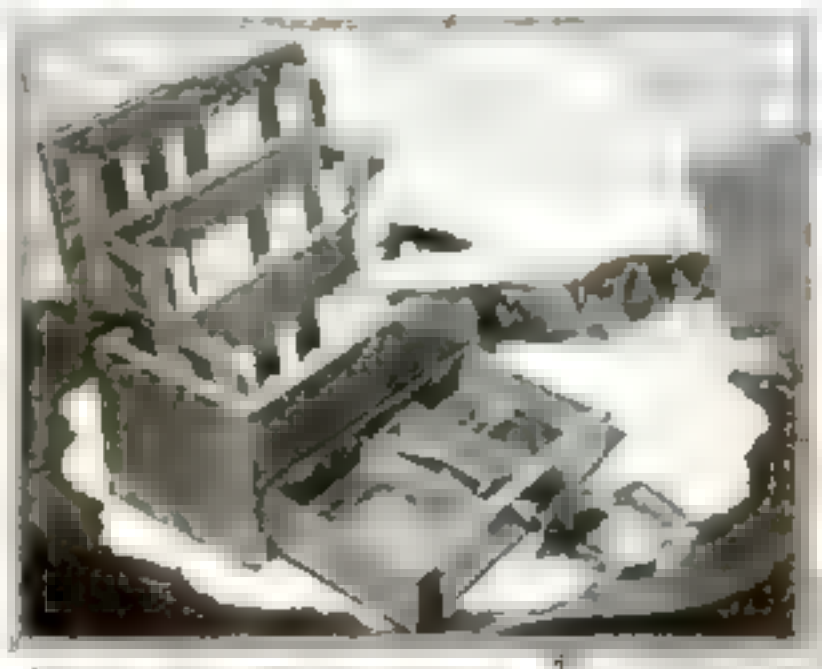


Made of cypress and given a rich brown Japanese finish, the completed box is attractive

A Trick Folding Cigarette Box

All you have to do is to pull open a small drawer, and a novel three-piece rack automatically appears like magic

By WALTER E. BURTON



Through a simple but ingenious lazy tongs arrangement, the act of opening the drawer causes the cigarette rack to rise.

CONTAINING thirty cigarettes, four ash trays, a lighter or box of safety matches, and a little brass statue or "stomper" used to press the life out of glowing butts, this novelty box adds to the attractiveness of any smoker's table. Furthermore, it measures only 4¼ by 4½ by 7¼ in.; and it contains mechanical features that make it as interesting to operate as a toy.

When the box is closed, the lid is held in place by a small snap catch, and it is impossible to open the drawer, which is fastened by leather hinges to the cigarette rack inside. To open, the catch is released and the drawer pulled out. This automatically raises the lid and unfolds the rack so that the cigarettes become accessible and the contents of the drawer are made available—all in one pull. To close the box, the operation is reversed and at the same time the lid is turned down. It is necessary, to overcome any slight binding of the leather hinges.

Although this sounds as if a complicated mechanism must be necessary, the construction of the box really is an easy project for any man with an average supply of tools. The dimensions of the various parts are indicated on the drawings on page 89. Cypress is used for all exterior parts and for the drawer, and walnut for the three sections of the cigarette-holding device.

In addition to the wood, you will need about an ounce of ½-in. or ¾-in. brass escutcheon pins, a small quantity of strip brass ¾ in. wide, a brass knob, two small brass butt hinges, two very short 8/32-in. bolts with nuts, four small roundhead wood screws, and a scrap of flexible leather. The total cost of materials should be less than one dollar.

First cut the parts for the box, including the drawer. Cypress ⅜ in. thick is used for all pieces except the bottom, sides, and partitions of the drawer, which are of ⅛-in. material. You will need two ends each 4 in. wide and 3¾ in. long. These are placed with the grain running vertically. The bottom piece measures 4½ by 6¾ in.; the back 3¾ by 7 in.; and the top, 4½ by 7 in. Across the front, at the bottom of the drawer, is a piece of 2 by ⅜ in. cypress. The drawer front is 1¾ by 7 in., and the drawer sides and back are 1 in. high.

Before assembling, give all exterior surfaces a sugi or Japanese driftwood finish, as follows:

With a blowtorch or gas flame, scorch the surface evenly but not deeply. Then, with a brass wire brush and a stiff scrub brush, remove all charred wood. This leaves the dense grain, now colored almost black, standing out in relief, both physical and tonal, against the rich brown of the softer portions. Two or three coats of wax, well polished with a brush, bring out the grain beautifully.

In burning the top-piece, give the edges a little more heating to round them. This treatment causes the cypress to warp and sometimes crack, but

How to Take Better Photographs

WHENEVER you build something unusual in your home workshop, you undoubtedly wish you could take as clear photographs of it as those, for example, which appear on this page. You can—even with a cheap camera. It is all in knowing how. And the secrets of doing it will be explained in a series of remarkable articles which begin in the June issue. These are by Frederick D. Ryder, Jr., samples of whose work appear on pages 85 and 86. Be sure to read every one of the articles, and try to win some of the prizes to be offered in conjunction with them.

the wood can be straightened by placing it under a heavy weight overnight with the burned surface in contact with damp paper; and the cracks add to the aged appearance.

Fasten the parts together with glue and brass escutcheon pins driven through small holes previously drilled for them. Arrange the pins so that their heads will form a kind of design along the edges.

The construction of the drawer is conventional, the front being rabbeted to receive the sides and bottom. Glue and small brads hold the joints. The drawer should slide snugly but smoothly into the bottom part of the box. If lubrication is required, use ordinary soap.

Now for the most interesting part—the cigarette rack. This consists of three walnut holders hinged together with parallel strips of brass so that they form a kind of lazy-tongs arrangement. Each of the holders is built up of three pieces. The central portion measuring ⅜ by 1⅜ by 6½ in., contains a row of ten holes bored to a depth of 1½ in. with a No. 7 auger bit and spaced on ⅝-in. centers. It is best to use a depth gage, but if some holes are bored too deep, pound crumpled tin foil into them to raise the bottoms. The two end strips attached to this bored section are ¼ by ⅝ by 3½ in.

How the rack is assembled. The three brass strips at each end are attached with brass escutcheon pins.

After the three sections of the cigarette rack are completed, arrange them side by side and clamp them in that position, as shown in the photograph above. Then mark the points where the pins that form the lazy-tongs bearings will come. The central piece has, on each end, three such pins or bearings, the end ones being 1½ in. from the center. The rear section or the one that later is fastened to the lid has the two lower bearings only; and the front or outer section, the two upper. Four two-hole and two three-hole brass strips are required. The escutcheon pins are riveted wherever the wood is thin.

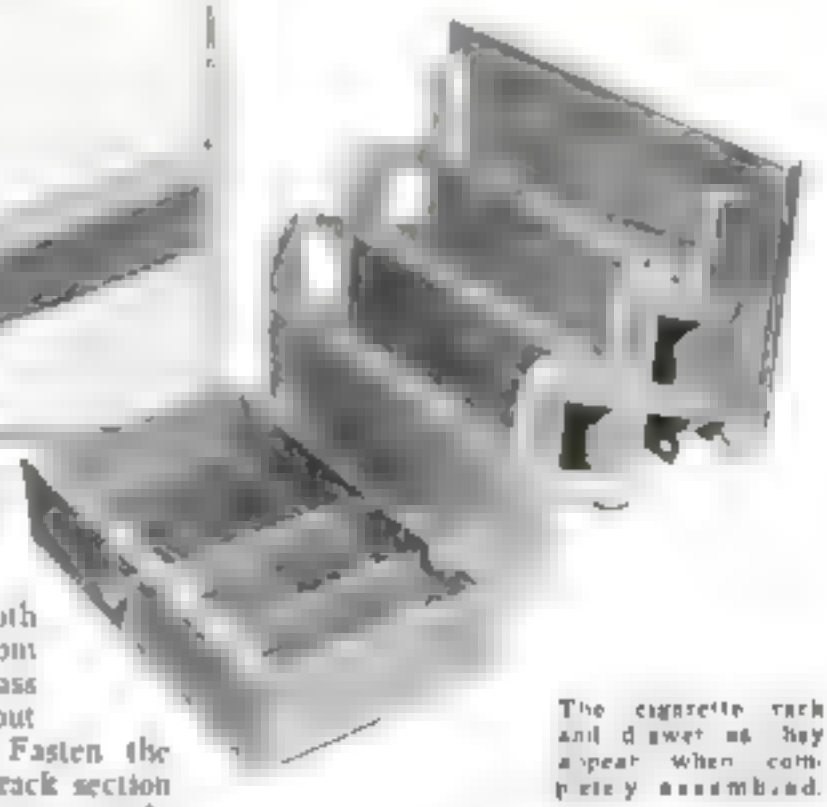
Glue and nail the rear section of the cigarette rack to the underside of the lid, taking care that it is correctly centered.

The lower edge of the front section of the rack is attached to the rear of the drawer by means of small strips of leather used as hinges. It is necessary to use such flexible material in order to assure smooth action and freedom from binding. Small brass hinges were tried, but did not work well. Fasten the leather pieces to the rack section with small wood screws, two in each hinge. Use short brass bolts for attaching them to the drawer back, because of the thinness of the wood. To avoid difficulty in fastening the hinges after the various parts are in place screw the leather first to the rack, then arrange the drawer and rack in proper relation and finally place the bolts.

The lid, carrying the rack on its undersurface is attached to the back of the box with small hinges. A small catch consisting of a strip of hammered brass with a hole that permits it to snap over a short pin, is attached to the lid with escutcheon-pin rivets.

Stain the inside surfaces an appropriate color, and finish with lacquer or wax. Attach a small knob to the drawer front. To ornament the surfaces, you can use escutcheon pins to work out a simple design on the front, top, and ends, if you desire.

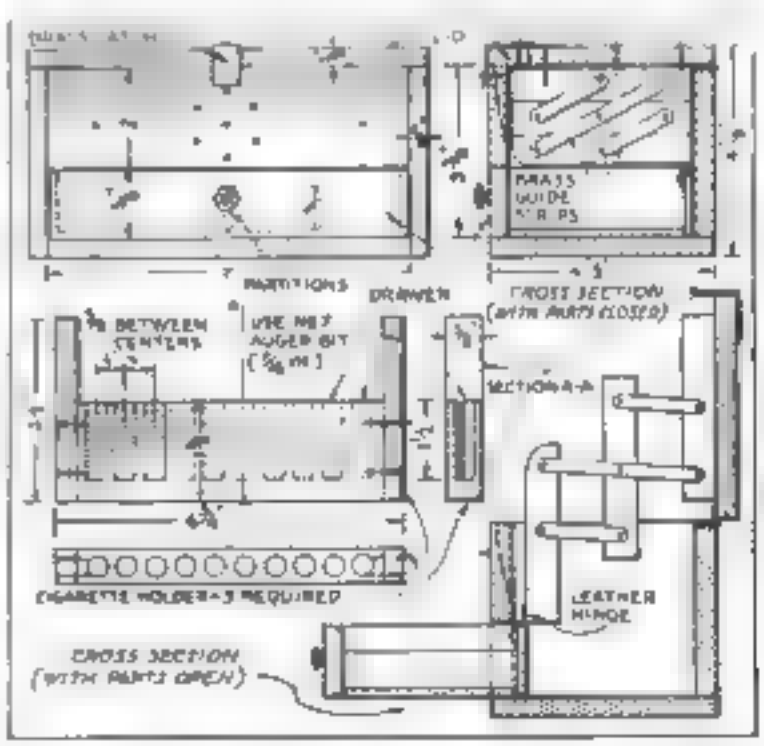
The Japanese driftwood or sugi finish is obtained by scorching the cypress over an open flame or with a blowtorch and brushing away the charred wood



A detail showing the construction of the drawer which has the sidepieces rabbeted into the front

The cigarette rack and drawer as they appear when completely assembled.

The drawer has two partitions, separating a nest of four brass ash trays (or even three or four nests), a brass "stomper" and a box of safety matches or a small pocket cigarette lighter



A front view of the box, cross sections of it open and closed, and one of the three similar cigarette holders.

Making a *Magic Skin* Tea Tray

There's a famous story connected with it which you can tell to amuse your friends

By CHARLES H. ALDER

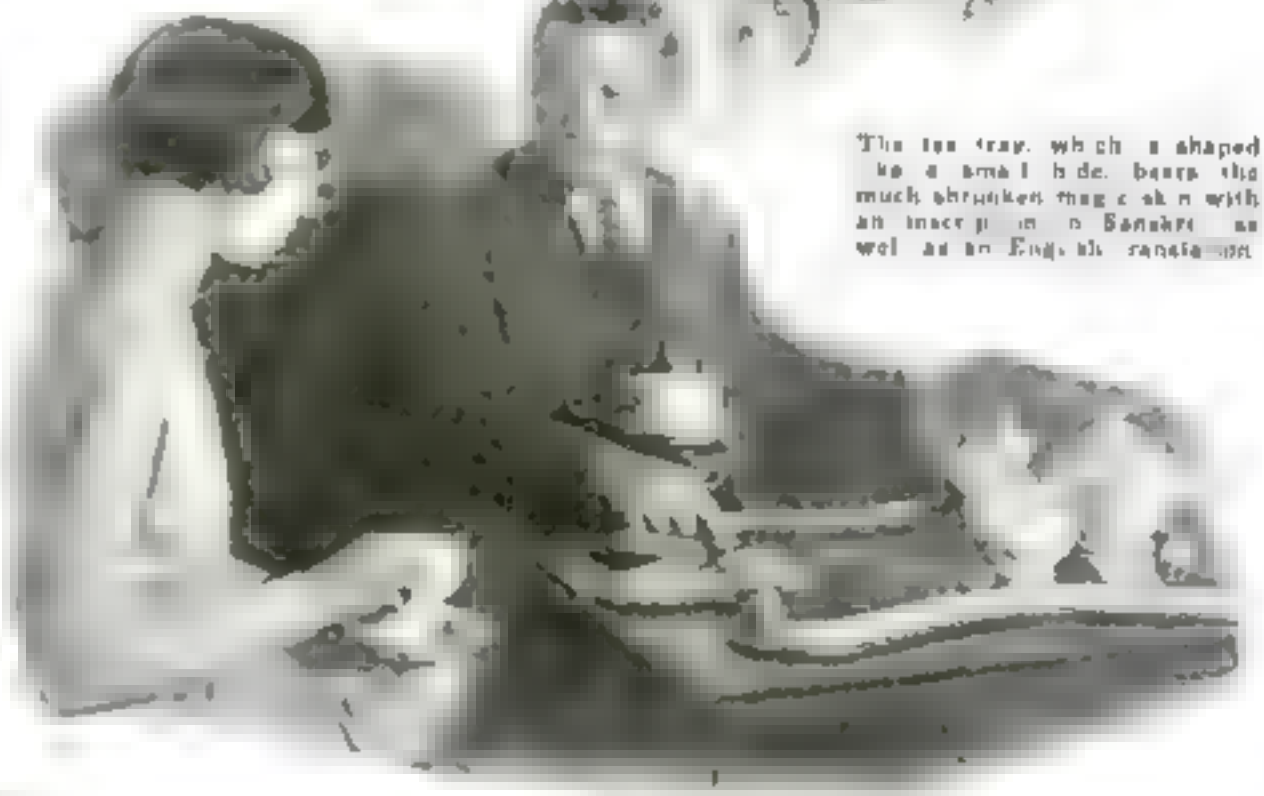
IN BALZAC'S famous tale, *The Magic Skin*, there is a description of the hide of a wild ass on which appeared in mysterious Sanskrit characters, as if inlaid the following legend:

Possessing me thou shalt possess all things
But thy life is mine, for God has so willed it.
Wish and thy wishes shall be fulfilled;
But measure thy desires according
To the life that is in thee.
This is thy life
With each wish I must shrink
Even as thy own days
Wilt thou have me? Take me
God will hearken unto thee
So be it!

Every time the possessor of this extraordinary shagreen made a wish, the skin would shrink, and every time it shrank its owner would draw a line around it to record its shrinkage, for it meant his life had been shortened in proportion.

Now, the skin I'm going to describe has the very same Sanskrit characters, but I can't guarantee its magical properties. It has, however, a real use—to ornament a tea tray. To make this skin, you will need a piece of chamois skin or other thin leather. If you use chamois, cut it to the shape and size shown on the accompanying drawing and dip it in any available dark stain, or dab on two or three different stains to give it an ancient look. When it is dry, apply several coats of shellac.

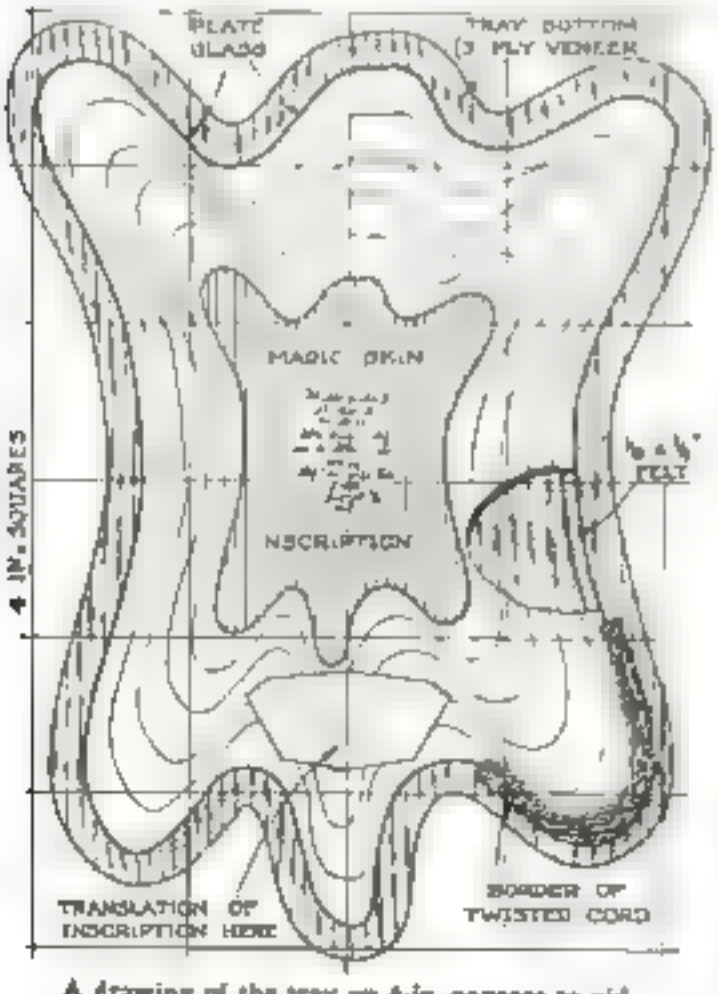
If you select a piece of dark leather, burn the edges with a hot soldering iron and rub the skin with brown shoe polish adding a few cubs of black polish. Make a small pear-shaped hole near the top, as if the skin had once been hung on a nail.



The tea tray, which is shaped like a small hide, bears the much shrunken magic skin with an inscription in Sanskrit as well as an English translation.

Letter the magic Sanskrit characters in the center of the skin with black India ink or burn them in. If you want to give the letters an even more mysterious appearance when the tray is used at night, go over the characters with luminous paint, but bear in mind that the paint must be exposed to light before it will give off a glow.

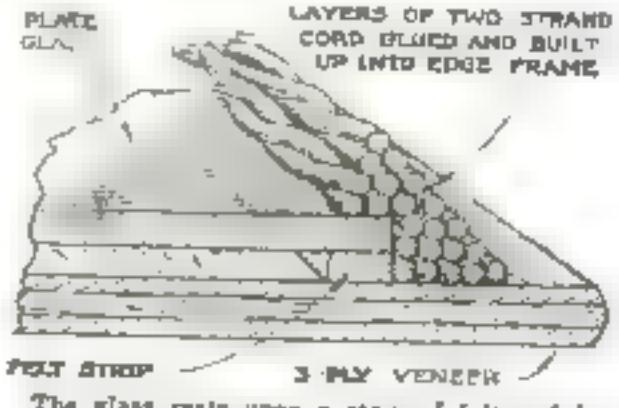
Next draw a pattern for the plate glass top and take it to a glazier, unless you have had sufficient experience to cut the glass yourself. Should you attempt to do the cutting, work very slowly and carefully and do not try to take off large pieces. When it is nearly cut out and a smile begins to creep over your face, rejoice not—wait until the last waste piece has been removed. Then rub the edges reasonably smooth with a piece of broken emery wheel dipped in water or any available sharpening stone, for although the edges will be hidden, it is better to smooth them so that you will not get cut while handling the glass prior to mounting it.



A drawing of the tray on 4-in. squares to aid you in making full size patterns for the parts.

Lay the cut piece of glass on a sheet of three-ply wood veneer and draw a line around it; then draw another line ¾ in. outside of this. Cut the wood to the outer line, sandpaper the edges smooth, and apply two or three coats of black lacquer.

Glue the magic skin on the plywood a little to one side of the center line, as shown, since the skin is not bisymmetrical and the supposed shrinkage would not be uniform. Draw or paint five lines on the wood to show how the skin has shrunk at each wish. Cement or glue on a neatly lettered or written translation of the San-



The glass rests upon a strip of felt and is fastened to the plywood with strands of cord.

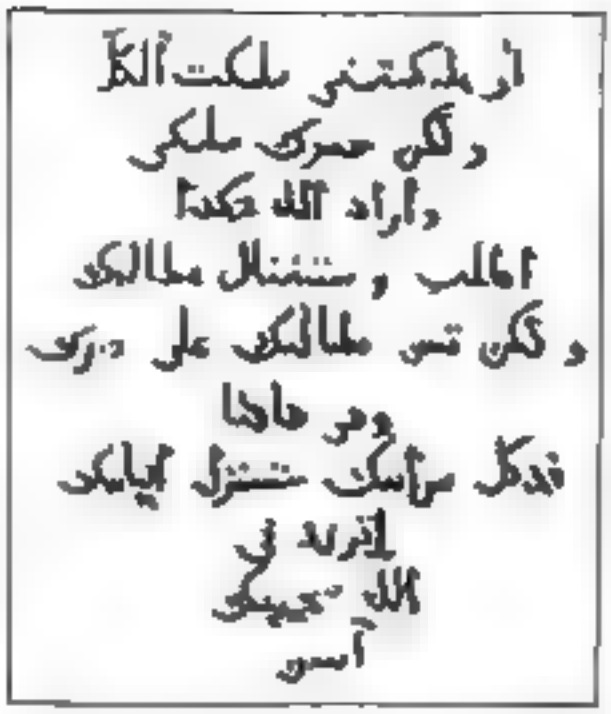
skrit in the position indicated. Then fasten a strip of felt ¼ in. thick and ½ in. wide around the pencil line which was previously drawn just where the edge of the glass will come, this is for the glass to rest on. Clean the glass thoroughly and lay it in place

You are now ready to bind down the glass with a twisted cord. Obtain a ball of cord about 3/32 in. in diameter and 150 ft. long and, if cotton, boil it to shrink it as much as possible. When it is dry secure one end to a post in the yard, grip the other end in the jaws of a hand drill or tie to an egg beater, and twist the cord the way it was originally twisted until it has a tendency to become kinked. Lay the end down and place a weight on the hand drill to hold it so the cord will not become tangled

At the halfway point, 75 ft. from each end, drive a stake into the ground. Pick up the end of the cord attached to the drill, walk around the stake, and tie the two ends together and to the post. Make a hook by bending a nail, and place it in the drill chuck, set the loose loop of the cord over the hook and twist the cord the way it tends to turn. Then wind the thin, two-strand rope so formed on a stick so that it can be handled conveniently

Wind the cord around the tray as illustrated, gluing it down as you proceed. Tuck in the end and let the glue Continue until the ridge is about ½ in. dry. Go over the binding, the edge of the tray, and the glass with a moist cloth to remove excess glue. When the cord is dry, give it two or three coats of lacquer of any desired color. I used lavender

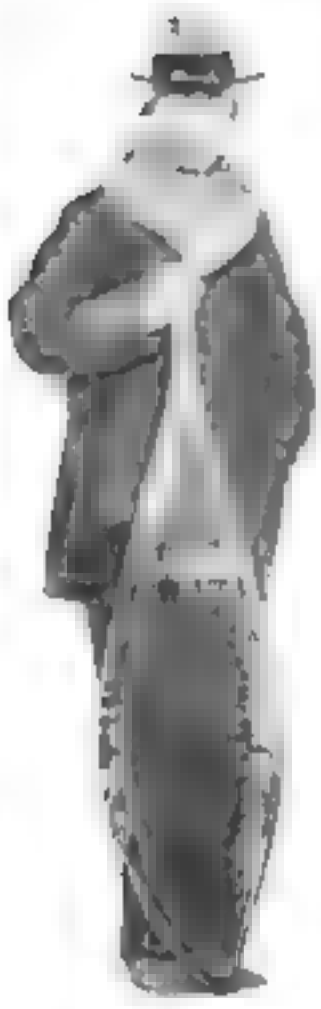
Your tray is now finished. If you have children, tell them the story of the magic skin and how it got smaller and smaller and smaller and S-M-A-L—but you know how to make their eyes widen and their breath come fast



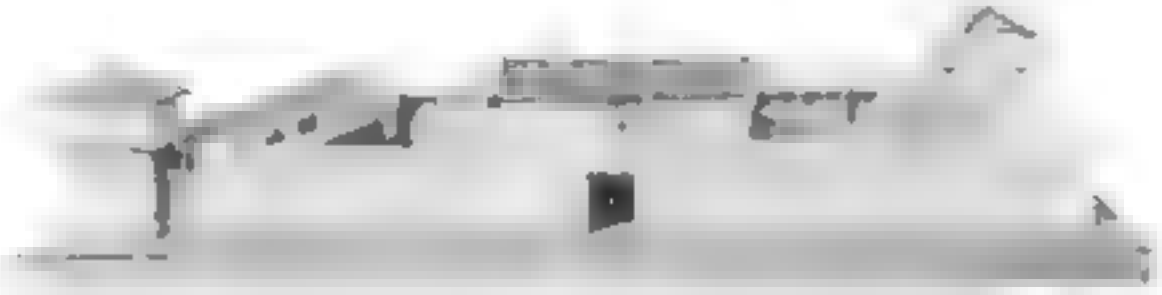
Copy this as best you can on the magic skin, but don't ask any of your friends to read it

How to Modelize Fort Union

Clarence E. Mulford brings to life a great trading post of the Old West and introduces a novelty for model makers



For more than thirty years Mr Mulford, who has written many thrilling stories of the West, has been building up a great card index system of data on the stagecoach era, the cattle trade, the fur trade, the Indians, the pony express, and related subjects. There are more than 16,000 cards in his extraordinary files. It is from this wealth of reference material he gathered the information about Fort Union which enabled him to build his accurate scale model of that famous trading post. This article, which gives a general description of the model, will be followed in the June issue by one containing working drawings and also the detailed specifications.



A general view showing the front or south elevation of the model and the front of the factor's house, 24 by 78 ft., which was the main building within the walls

PERHAPS only the zealous history hound, hard-bitten by the romance of the West in the interval between Manual Lisa's first expedition up the Missouri River in search of furs and the dying out of the great western cattle trail, might be expected to find Fort Union a fit subject for model making. Yet, because of its novelty and its historic significance it should appeal to many readers of POPULAR SCIENCE MONTHLY who have built models of ships, stagecoaches, and covered wagons.

Fort Union, the keystone trading post of the American Fur Company on the north bank of the Missouri River in Montana and almost on the Dakota line was the greatest trading post in the world, rivaled in size and perfection only by Fort Laramie and Bent's Fort. As a picturesque symbol of the fur trading days of the West, a model of it might possibly be made on a scale of 1/16 in. to 1 ft., which would be small enough for any home but a scale of ⅛ in. to 1 ft. is four times more satisfactory and still keeps it nearly within the home-model class. The best scale—and that of the model illustrated—is 3/16 in. to 1 ft. This means, however, a base 4 ft. wide and 4½ or 5 ft. long

Being blessed with the space for a model room, I am not crowded out of the house by it. Even more, I hope to add scale models of Bent's Fort, Fort Laramie and Fort Hall. With these and my collection of scale models of vehicles and boats used in that country prior to the completion of the Union Pacific, I shall have modelized that period of the history of the West rather thoroughly.

The fort was begun in 1829, completed in 1833, and sold to the U. S. Government in 1860, then it was torn down and its materials hauled off for the erection of Fort Benton, across the North Dakota line. It faced south and the Missouri flowed twenty-five paces from its gates.

It was 220 ft. long along its south and north ends, 240 ft. long on the east and west sides. The palisade was 20 ft. high built of cottonwood pickets 20 ft. long and rounded out by ads to 12 in. square. This

West end of the factor's house. It was of frame construction and planked inside and out. Behind it is the log cookhouse

palisade was not sunk into a trench, but rested on a stone foundation which came up just above the surface of the ground This was so that the pickets would not rot off, but it made necessary an inner frame of 12 by 12 s and connecting cross braces to keep it from falling over. The platform or banquet, made of whipsawed planks, ran from crosspiece to crosspiece paralleling the palisade, and provided a walk along the walls

The pickets should be rough, square, and silvery gray in the south wall (sun-bleached darker in the north wall, and the two shuffled in the side walls. They should vary a very little in size, and give a rough rather than a smooth wall. The rails, one at the very bottom of the pickets and the other 5 ft. down from the top are double, two 12 by 12 s side by side, making the rails 1 ft. thick and 2 ft. wide They may be continuous strips running full length of the palisade

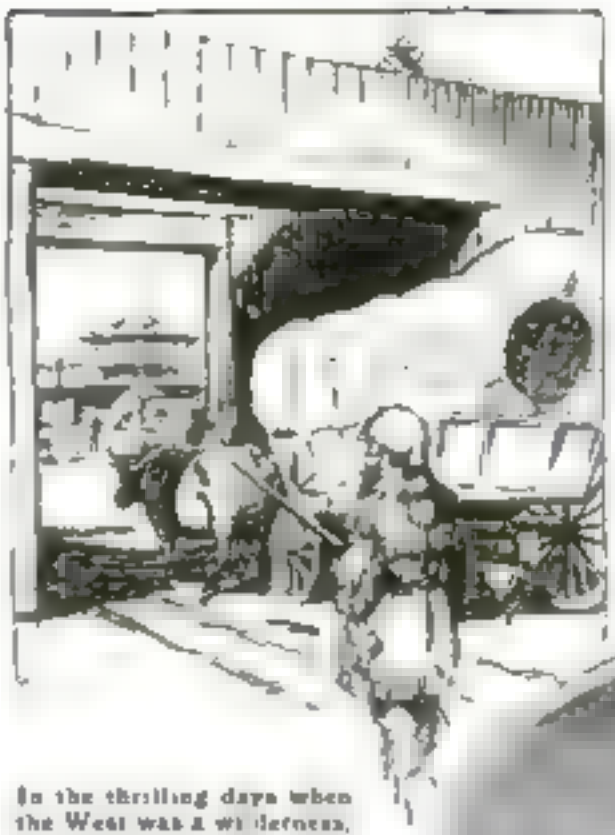
The pickets should be glued and bradded to the rails, each nail hole being made with a No 65 drill for ½-in. No. 20 brads with small heads. If the holes are not drilled, the rails will split from so many close-set brads. If the brads are staggered a little so much the better. In the building of this model, glue everything and use brads unsparingly The logs in the walls of the buildings should each be pinned to the one underneath by brads, excepting where the doors and the windows will come

The two outer edges of the logs in the buildings should be slightly beveled so as to make them stand out and look like the separate pieces which they are. They should be rough, and if bark can be simulated, so much the better

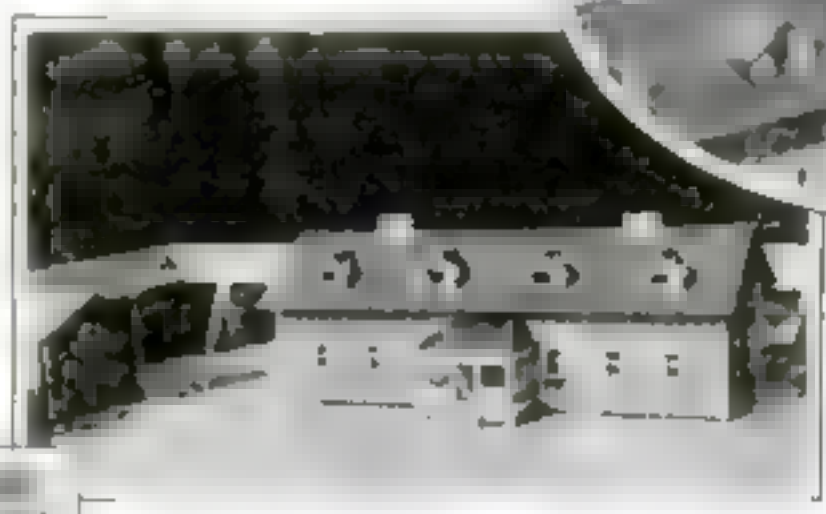
The inner walls of all log dwellings were faced with planks standing vertically These planks should be somewhat less than ½ in. thick and may be planed

The roofs of all the buildings were shingled (3. 16 in. square to the weather on the scale of my model) and painted red. After wrestling with the problem of 24,000 individual shingles, I decided that red cardboard, a T-square, and India ink would answer the purpose

Working drawings of this model will appear in the June issue

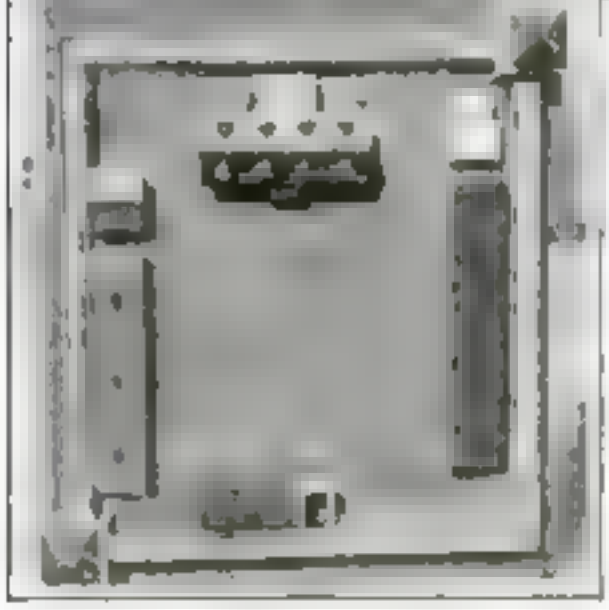


In the thrilling days when the West was a wilderness, Fort Union, on the Missouri River was a landmark.



How heavily fortified Fort Union was can be estimated by this view of the northeast bastion. Note the ladders balcony, and doors also the magazine with its 4 ft. thick walls of stone

The factor's house which contained living quarters, mess hall, and office The ice house is visible at the left



The general arrangement of old Fort Union is shown in this bird's-eye view of the model.

Other Western Models

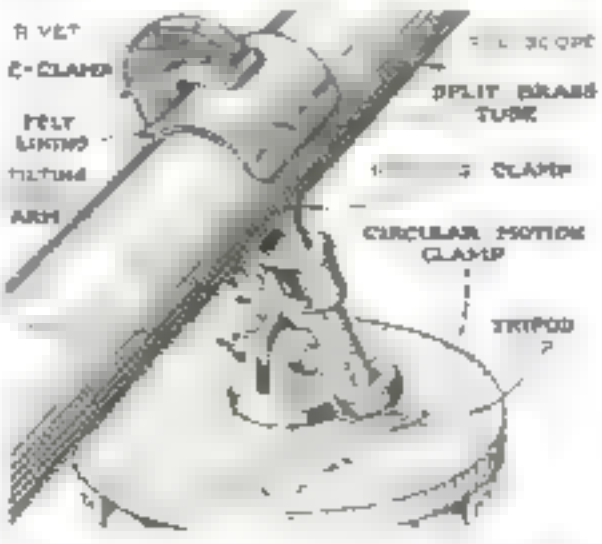
Through novels and moving pictures, every model maker is familiar with the thrilling history of western exploration and settlement. It was an amazingly picturesque period, and one that suggests many significant models; for example, a covered wagon, a Concord stagecoach, and a Mississippi stern wheel steamboat. POPULAR SCIENCE MONTHLY lists accurately scaled blueprints for all of these see the list on page 110).

THIS PORTABLE TELESCOPE COST $15

ONE observation of Saturn with its beautiful ring system would repay anyone who is astronomically inclined for the slight expense and work necessary to construct this portable telescope outfit The telescope, which was purchased new for $13.98, has a 2-in. objective; with a celestial eyepiece, it gives a magnification of sixty-eight diameters.

To support the instrument a heavy camera tripod is used. The universal clamp for attaching the telescope to the tripod is made as shown in the accompanying drawing from a ten-cent C-clamp with an opening of 4 in., a section of brass tubing split in half, a piece of strip steel, a forked support with a flanged base and a screw which projects through the top of the tripod, a wing nut, and a short bolt which passes through the forked support and the end of the twisted steel strip. The wooden carrying box is large enough to contain the folded tripod, telescope, clamp, and eyepiece box. The cost did not exceed $15.

Even if a larger instrument is acquired later, the portable outfit is always convenient for celestial and terrestrial observations.—DON H. JOHNSTON



How to construct the inexpensive clamp for attaching the telescope to the heavy tripod

With this telescope you can see the belts of Jupiter and sometimes the polar caps of Mars.

After a dusty trip you can spruce up quickly with this

Leather Covered Whisk Broom *and* Shoe Polishing Kit

By F. CLARKE HUGHES

THIS combined dustbrush and shoe polisher will appeal to every traveler and motorist. It is indeed, an almost indispensable article. After a drive in the country both brush and polisher are always useful; and in this compact form they take up so little room that they can be carried in the pocket of one of the automobile doors or in a corner of even the most crowded traveling bag.

Any small whisk broom may be used in making the kit. A number of different types are to be found in five-and-ten-cent stores and department stores. The leather for the case or covering may be almost any substantial leather. If a tooled design is to be used, a piece of tooling calf should be selected; otherwise the range of choice is quite wide.

For the polisher, a piece of sheepskin with the fleece still in place may be purchased in any large leather store and at some shoe findings stores and harness shops, or possibly the reader has a discarded fleece-lined coat or jacket, such as aviators and woodsmen wear, from which he can cut a piece of sheepskin. Another expedient is to buy a cheap sheepskin shoe polisher of either the wood-mounted or folding type and remove the fleece. It may be somewhat narrow for the design illustrated, but it can be made to serve satisfactorily.

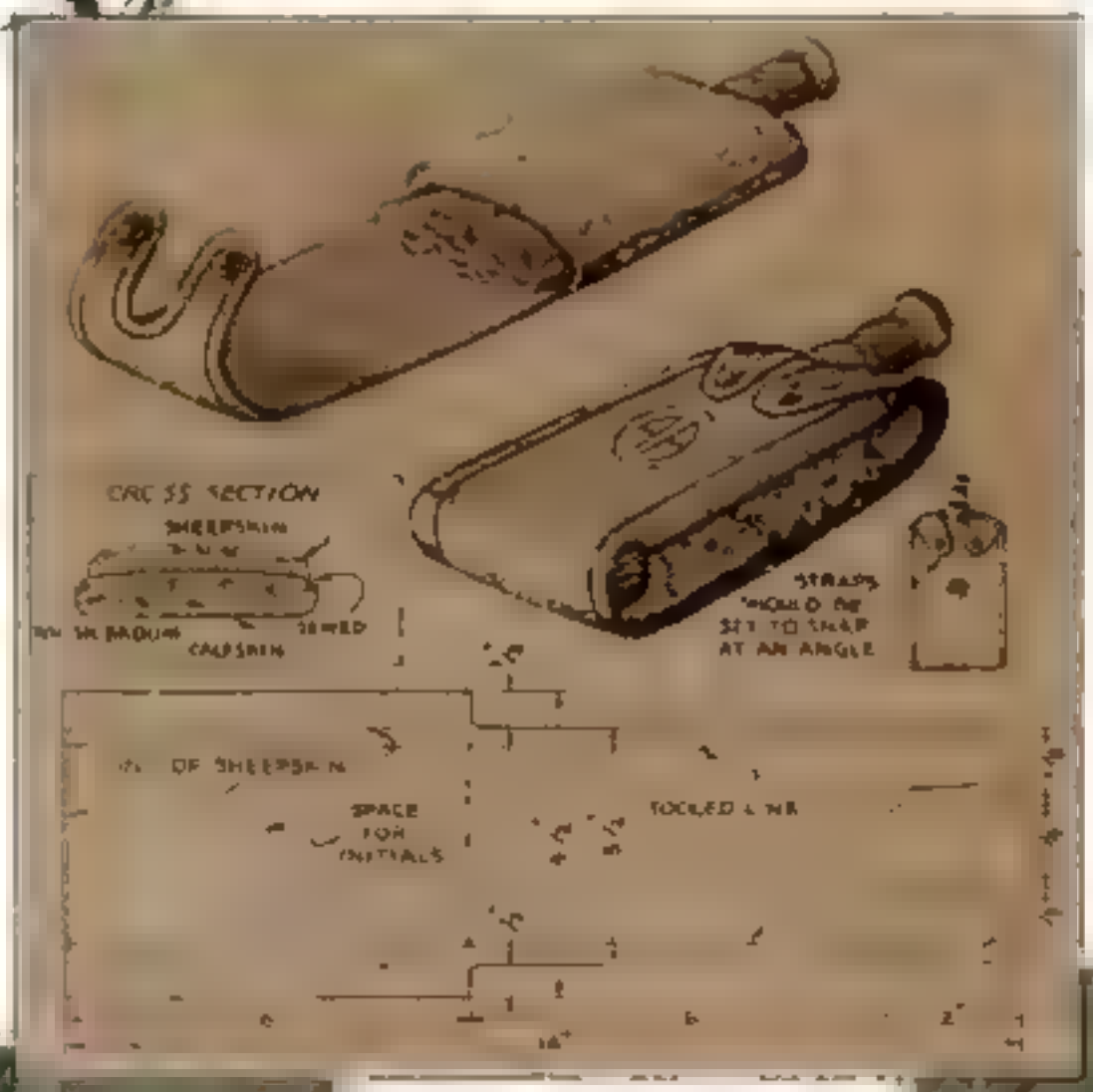
The dimensions given on the accompanying working drawing are intended merely as a general guide. It is best to cut a paper pattern to fit the whisk broom as shown in the right-hand photograph below; then the case is certain to be large enough. The relative size of the fleece polisher as compared to the outside casing is indicated by the dotted lines on the working drawing.

The sheepskin may be attached to the casing in any one of several ways—it may be stitched by hand with a thread having a needle at each end as described in former articles, it may be taken to the shoemaker to be sewed on a machine; or if the edge of the casing is to be laced the sheepskin may be held in place by the lacing in which case no sewing is necessary.

In decorating the leather a number of methods may be followed, but it is suggested that a very plain finish be chosen, with perhaps a simple tooled vein or line around the edge. Initial letters or a monogram, if not too ornate, improves the appearance, as does a tooled edge such as that used on a number of projects previously described in this series of articles.

It is best to take the case to a shoemaker to have the snaps put on.

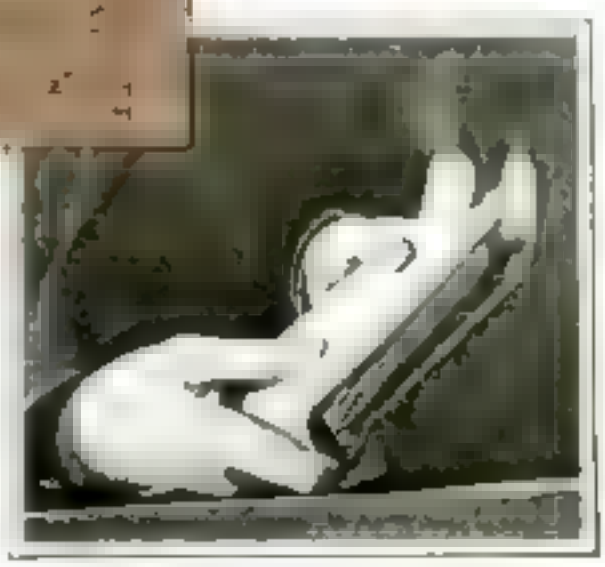
A wax polish applied to the surface when all is finished completes the work and leaves the leather bright and attractive looking.



The kit open and closed, a pattern for the leather and a cross section showing how the sheepskin is sewed.

At left. The materials needed are a piece of tooling calf or other substantial leather, a bit of fleecy sheepskin, and a small whisk broom.

At right. Fitting a paper pattern around the whisk broom so that no mistake will be made in cutting the leather. When doing leather work it generally pays to make a pattern

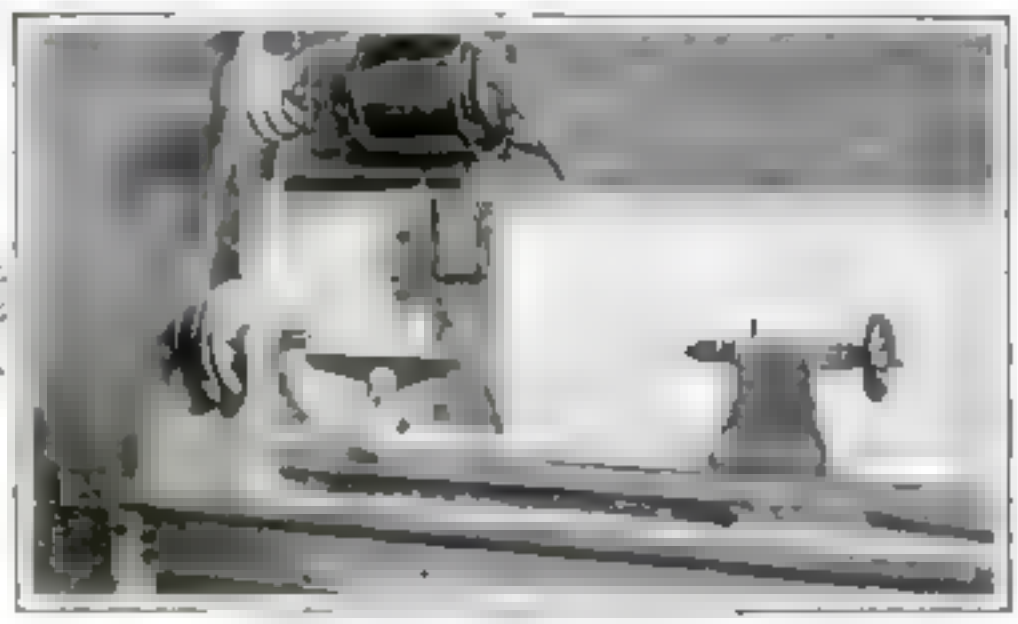


How to Grind and Hone Your Wood Turning Tools

Pointers on the care of a lathe and on the best way to center the work

By W. CLYDE LAMMEY

Fig. 1. Good equipment and properly sharpened tools are essential for satisfactory wood turning. At the right is shown a typical lathe with a cone pulley drive



MANY excellent small wood turning lathes are now available. They may be classified roughly into two divisions, depending upon the way in which they are driven. One type has a cone or step pulley on the headstock and is driven by means of a belt from a similar pulley mounted on a countershaft which, in turn, is driven by a motor or engine. A typical small lathe of this kind is illustrated in Fig. 1. The other type has the motor mounted on the lathe bed as part of the headstock; this is shown in Fig. 2. Both types are equally good for the average work.

A lathe should always be set on a solid bench or floor. In fastening a bench-type lathe to the bench top, see that the bed is not sprung when the bolts are tightened. Keep all bearings oiled and blow the dust out of the motor windings occasionally with an auto tire pump. If the machine must stand unused for some time, particularly if in a basement, cover all bright parts with heavy oil, and protect the whole machine with a cover made from canvas. Do not use cup grease or hard oil, as this will corrode bright metal surfaces.

On some small lathes the centers are tapered and fit a hollow spindle. Before replacing the centers, put a few drops of oil on the tapers.

The wood turning lathe tools in ordinary use are six in number—the gouge, the round-nosed tool, the square-nosed tool, the spear- or diamond-point tool, the parting tool, and the skew chisel. In Fig. 3 at the bottom are shown the cutting edges of these tools. Sizes which are well adapted for use with small home workshop lathes are ¾ in. for the gouge, ¼ in. for the round- and square-nosed chisels, and ½ in. for the other three. The angles at which the tools are beveled for average work are also indicated in Fig. 3.

Good turning begins with sharp tools—tools that have been correctly ground and honed. In the beginning one will do well to invest in a high-grade, fine-grained emery wheel with an adapter to allow it to be used on the lathe spindle as shown at *D*, Fig. 3. An oilstone *C* is also necessary and either or both of the slip stones shown at *A* and *B* will be required. The slip stone *A* is slightly oval and tapers to about ¼ in

Fig. 2. This is a lathe which is driven by a motor mounted directly on the headstock. The choice of lathe is largely a matter of personal preference.

Fig. 3. Grinding a gouge on an emery wheel held on the lathe spindle by means of an adapter. Here the tool is shown as the handle is being moved over to left. Compare this with Fig. 5.

Fig. 4. How the diamond-point tool is ground. It has two 30° bevels on the same side, and these meet at the center coming together at an angle of about 60°. For the exact shape of this and other tools see the lower drawings of Fig. 3.

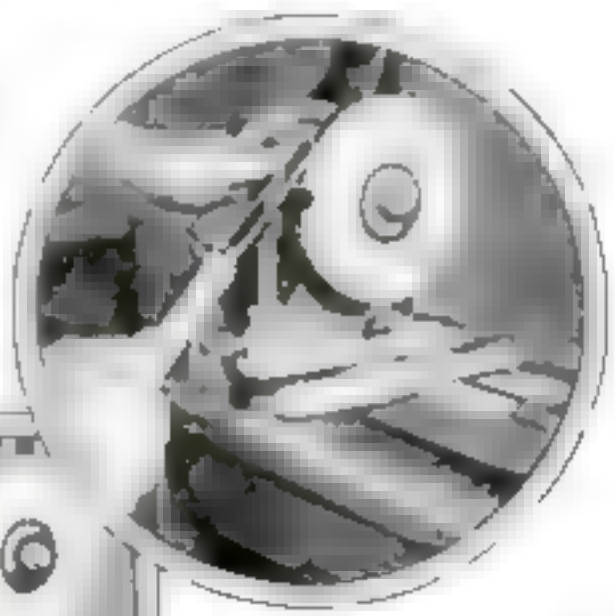


Fig. 5. The starting position for grinding a gouge. The tool is swung towards the left and revolved in the same direction.

in diameter at the small end. This is perhaps the better of the two shown for whetting a turning gouge, though either will do.

The turning gouge and the round-nosed tool are perhaps more difficult than the other tools to rough-grind, and inasmuch as they are on the average the most used of all, they should be ground with especial care. While there is no absolute rule for the degree of bevel on a turning gouge, round- or square-nosed tool, ordinarily it should be slightly less than 35° with the length. Generally speaking, this means that the resulting bevel is about twice as long as the tool is thick, which is a reasonably safe degree of bevel on the three tools mentioned. The shorter the bevel, the longer the edge will hold up

Place the emery wheel with adapter on the lathe spindle, bring up the small T-rest and set it squarely in front of the wheel with the top of the rest about ½ in. above the axis, provided the wheel is 5 in. or more in diameter. The rest should be at least ¾ in. from the face of the wheel

Start the lathe, lay the gouge on the rest, drop the handle below the horizontal about 40°, and swing it about 10° to the right. Tip the tool sideways to the right as at *E*, Fig. 8. Bring the side of the bevel in contact with the wheel and simultaneously swing the handle slowly to the left, at the same time, revolve the tool in the same direction, the handle moving through an arc of about 20° from the right-hand position. Continue this operation from left to right and the reverse until the bevel is finished to a sharp edge (see Figs. 3 and 5). Use only a light grinding pressure, and dip the tool frequently in water to prevent overheating and drawing the temper. Watch that the bevel is ground to a true arc, so that one side will not be higher than the other

The round-nosed tool is ground in the same manner as the gouge, save that it is not necessary to tip it sideways. Especial care must be taken to grind the cutting edge to an even arc, and particularly to avoid "pointing" the edge, that is, the sides should not be ground straight and only the nose rounded. The cutting edge should be as nearly a semicircle as it is possible to make it

Grinding the square-nosed tool is simply a matter of keeping the cutting edge square across and the bevel to approximately 35°. The diamond tool is ground as shown in Fig. 4 with two 30° bevels on the same side, forming two cutting edges that meet at the center of the flat side. For average purposes, these should form an angle of 60°. Be particular that the bevels meet at the center and that each makes the same angle with the center line of the tool.

The two bevels of the parting tool are best ground by hand on the oilstone; it is of the greatest importance that the edges coincide with the ribs on each side that is the bevels must meet to form the cutting edge exactly at this point, otherwise the tool will bind in the wood and is likely to be thrown violently out of the hands

In grinding the skew chisel see that the two bevels form an angle of 60° and that the cutting edge is at a 60° angle with the length. It is necessary to be very careful that the bevels are the same length so that the edge formed will be in the exact center

Rough grinding with the emery wheel leaves a wire or feather edge and this must be removed by honing on a fine slip stone and the fine side of an oilstone. Set the round edge of the slip stone in the hollow of the gouge as at *F*, Fig. 8 and hone the edge of the tool by sliding the stone back and forth at the same time imparting a slight rolling motion. The round- and square-nosed tools are honed as at *G*, the tool is turned with the bevel up and honed with a straight back-and-forth stroke

The diamond tool may be honed in the

Fig. 6. Using a dovetail saw

Fig. 7. Driving the spur [illegible] the end of the stock

[illegible] way but be careful not [illegible] tool is used flat on the stone so that the cutting edge is not rounded over from the top. The parting tool is honed exactly as it is ground, the fine side of the stone being used. The skew chisel also is honed on the fine side of the stone

Once the tools have been carefully sharpened, be particular that they are not nicked by rough handling

The turner should not overlook the importance of centering the work carefully in the lathe. This is particularly true of leg turnings, which tend to vibrate at high speed if not exactly centered. Before attempting to center a square of wood accurately make sure that the piece is planed out straight on all four sides.

Locate the centers at the ends by sawing diagonal kerfs about 1/16 in. deep, the saw kerfs running out exactly at the four corners as shown in Fig. 6. Then set the spur (live) center with its point on the intersection and the four driving nibs or lips directly over the saw kerfs, and drive it into the wood with a mallet—never use a hammer—taking care to hold the center exactly upright (Fig 7) Sink the cup (dead) center into the opposite end driving it down until the rim makes an impression in the wood.

When mounting the work between centers in the lathe be very sure that the dead center engages the work in the same impression made when driving it into the wood. Run the tailstock up just enough to hold the work in place and then put a few drops of oil where the dead center engages the wood

In a following article, Mr Lammey will tell how the principal turning cuts are made and give a number of invaluable pointers on producing clean-cut work

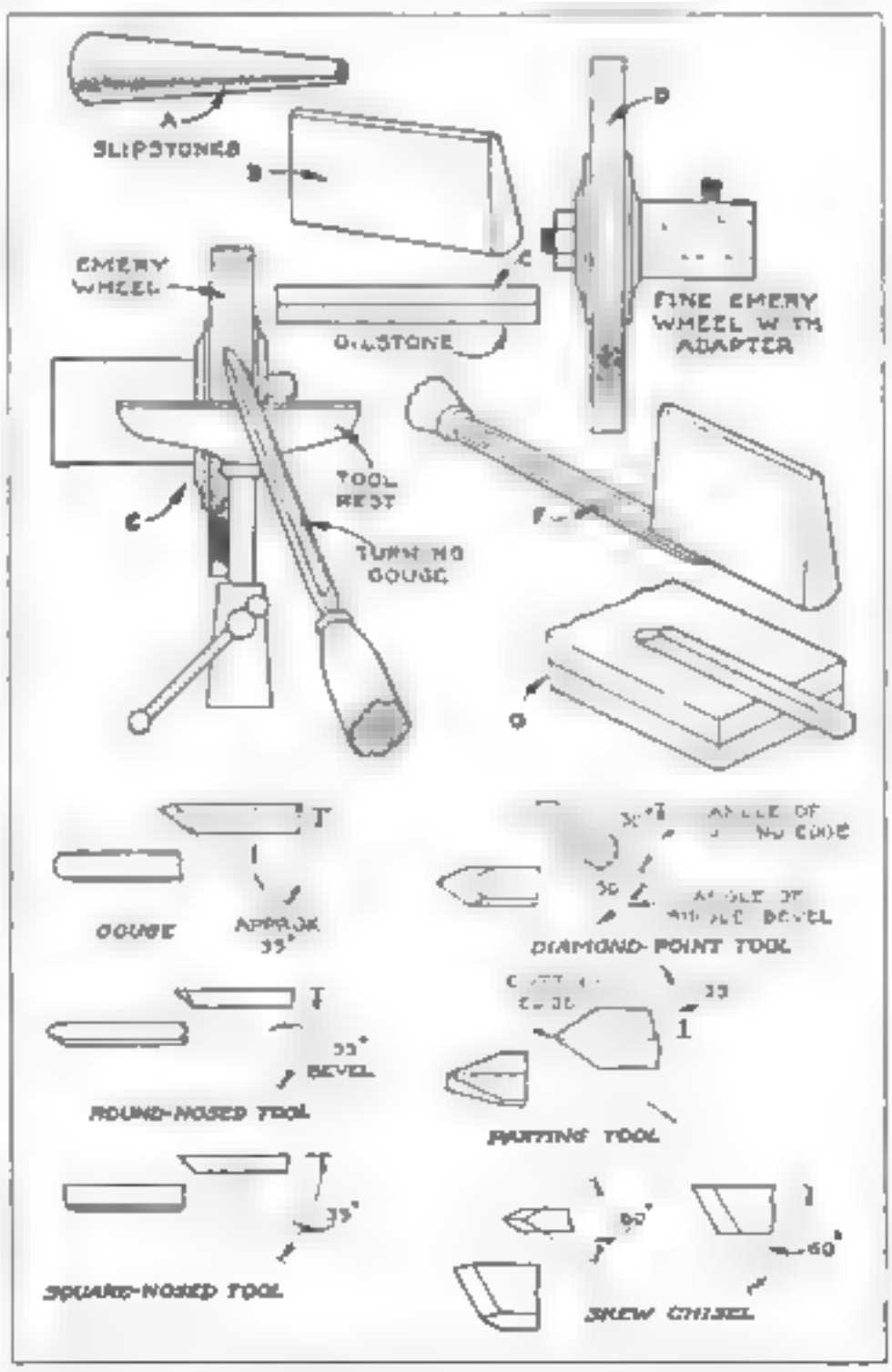


Fig. 8. Stones for honing wood turning tools, an emery wheel for use in a lathe; methods of sharpening, and the shapes of the various tools.

Ideas of Value to Car Workers

Mechanical Assistant Helps in Taking Nuts from Oil Pan Bolts—Mica Tests Plugs for Internal Shorts

AS IT is impossible on most cars for one man to reach both the bolts and the nuts on the oil pan from one position, it is common practice to have an assistant remove the pan. Figure 3, at right shows how to make a mechanical assistant. The counterwright at the end of bar *B* holds the socket wrench in place and a properly placed foot will keep it from turning

A SPARK plug that functions in the open air may not work in the cylinder because the compressed charge of gas offers greater resistance to the spark than does air at atmospheric pressure. Figure 1, below, shows how to test a plug for internal shorts. Placing the mica as shown increases the gap and the spark jumps internally if the plug is defective.

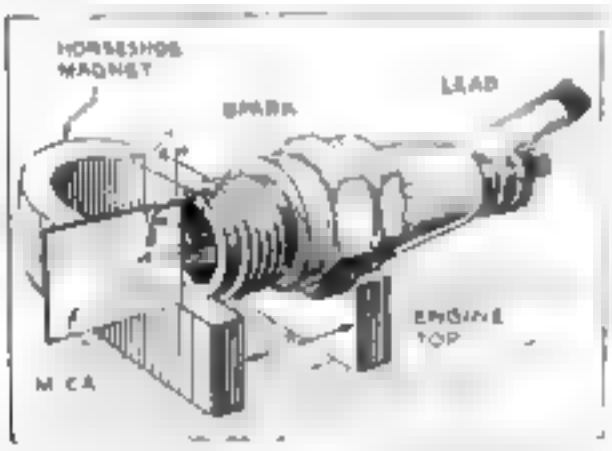


Fig. 1. Mica, placed as above, can be used to make a quick test of plugs for internal shorts.

WHEN air pressure is available, the simple method shown in Fig. 2, below, permits quick changes of the valve springs on overhead motors. The piston should be set exactly at top dead center before the air pressure is applied. The valve stem can be fitted to a spark plug of the take-apart type.

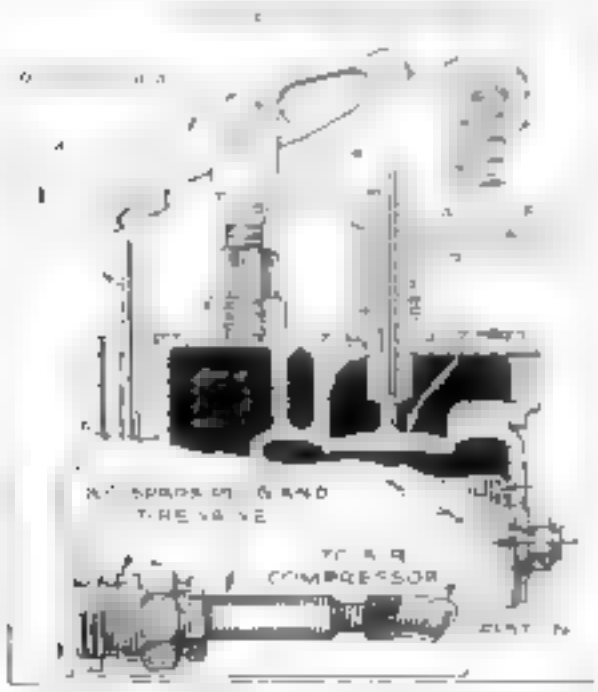


Fig. 2. Air pressure used to make a quick change of valve springs on overhead motor.

Fig. 3. Time and effort are saved by rigging mechanical assistant in turning oil pan nuts.

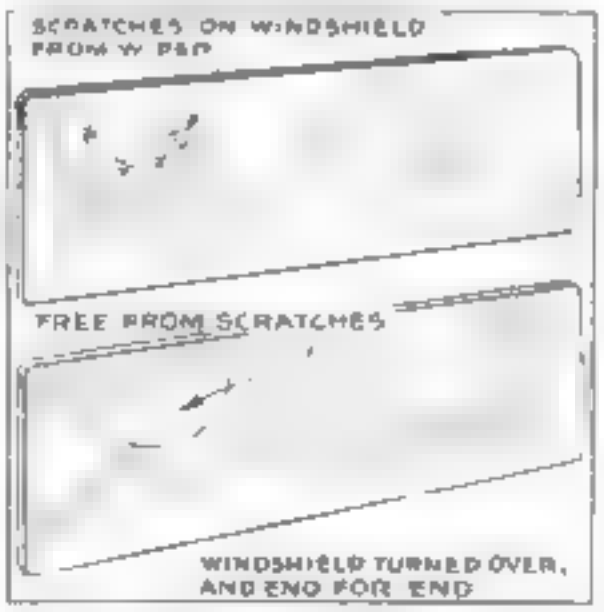


Fig. 4. Turning the windshield over and end for end gets scratches out of driver's vision.

AFTER a car is a year or two old, the owner discovers that the windshield glass in the path of the windshield wiper is covered with minute circular scratches that catch and reflect the light and so interfere with vision. These scratches are caused by tiny particles of sand from the road which are rubbed back and forth by the wiper the rubber itself not being capable of causing scratches. Figure 4, above shows how to make the windshield last longer by placing the scratched portion where it is not in the line of the driver's vision.

POPULAR SCIENCE MONTHLY awards each month a prize of $10, in addition to regular space rates, for the best idea sent in for motorists. This month's prize goes to R. A. Mercier, Pennacook, N. H. (Figure 3). Contributions are requested from all auto mechanics.

THE principal cause of valve sticking is hard carbon deposited on the valve stems and in the valve guides. The carbon on the stems can be removed easily with a dull knife and the stems polished with crocus cloth. Figure 5, below, shows an easy way to remove the carbon deposit from the valve guide. Brass wire brushes to fit any size bore from a quarter inch to a half inch in diameter can be purchased in any sporting goods store.

Fig. 5. With the use of this wire brush carbon is cleaned from the valve guide.

FIGURE 6, below, shows how to make a common flashlight into a circuit tester without spoiling it as a flashlight. Cut off the bottom end of an old flashlight and solder it to the cap as illustrated. The spring is insulated from the bottom cap by one or two fiber washers.

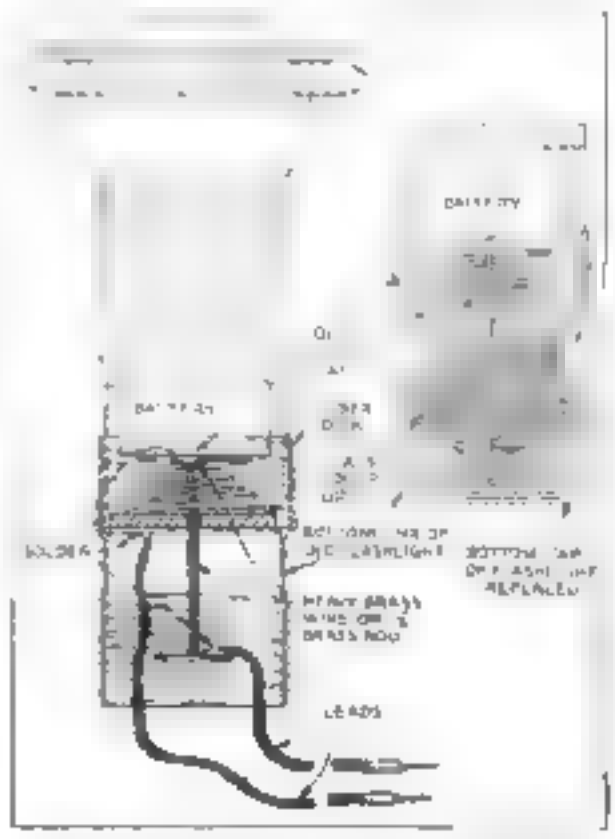
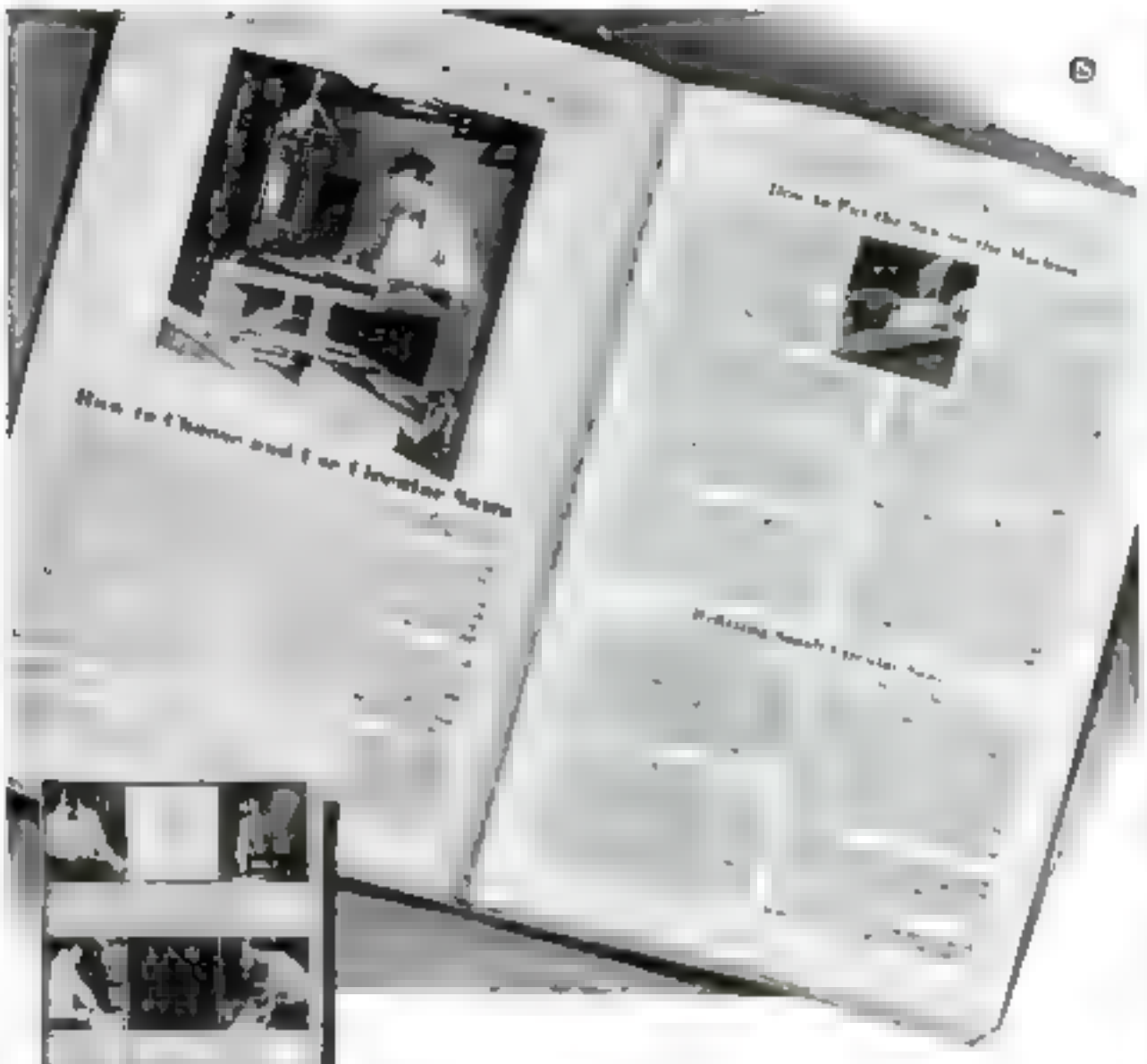


Fig. 6. How a flashlight can be used to test a circuit without spoiling it as a flashlight



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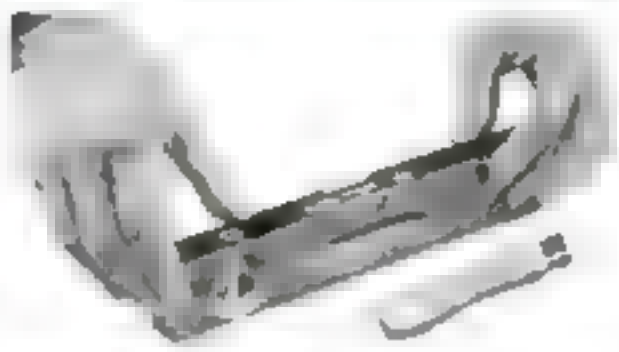

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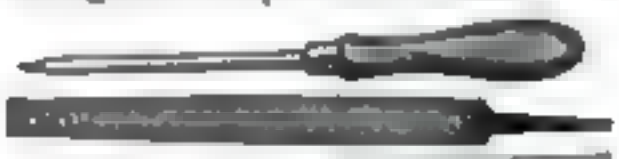

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By salvaging worn-out tools, the unit cost of each is greatly reduced

Hints on Salvaging High-Speed Tools

How to reduce costs in the small shop by reclaiming worn or damaged cutters

By HECTOR J. CHAMBERLAND

VALUABLE high-speed tools often are discarded in the small machine shop long before their useful life is over. They could be salvaged at a fraction of the cost of providing new tools, and in any large manufacturing plant where a careful study is made of all ways to reduce waste they would be restored to usefulness. Unfortunately, the average machine shop has a tendency to overlook the salvaging end of the business because there is no department especially designated to look after such work.

Executives tell us that tool cost in many cases governs the success or the failure of a machine shop, speaking from the purely business standpoint. A $50 tool may do a dozen $50 jobs; on the other hand, through carelessness or some other unexpected cause, the same tool may fail on its initial performance. Even in the small tool crib, the milling cutters, end mills, reamers, counterbores, drills, and other modern tool equipment, all of high-speed steels, represent a substantial investment

The chief reasons for the breakage of cutting tools in the shop are too much speed and improper clearance angles. Any damage therefore should be checked up carefully as to these errors before any blame is attached to the quality of a broken tool. In spite of every care, accidents will happen, and it becomes necessary to find an immediate answer to the question, How can such tools be repaired at a nominal cost so as to make them further serviceable?

Furthermore, even when a tool has never been damaged, it becomes unfit for service after many succeeding grinds. The teeth of a milling cutter, for example, become considerably shortened if not almost entirely removed, thus causing the tool to be of little value because of the lack of chip clearance

The fact that the structure of high-speed steel causes it to harden all the way through makes it possible to recut new teeth without resorting to the annealing process and the use of the milling machine This is the true art of cutter salvaging—the cutting of new teeth by the grinding method

There is nothing to perplex the operator in recutting teeth by grinding. It is simply making the grinding wheel do what is ordinarily required of the milling cutter. The work is done on any universal cutter grinder

The wheel speed should be variable for wheels from 3 to 7 in. in diameter. The wheels themselves should be of a grain and grade that will cut freely and not heat the work to any great extent. Grinding wheel manufacturers will gladly recommend the combination they have found best suited for this work. Aundum wheels (Nos. 36 and 46 J) have been used by the writer with very satisfactory results. Carborundum sticks instead of a diamond, should be used in shaping and dressing the wheel. This will insure cool and free cutting results because a good, open grain will be maintained

In the reclaiming operations to be described in this and an article to follow the writer will endeavor to demonstrate various short-cut methods and estimate the savings thus effected by comparing the initial cost with the salvaging cost. The latter will be computed on the basis of 75 cents an hour for labor and a 100 per-cent allowance for overhead, these figures being well above the average.

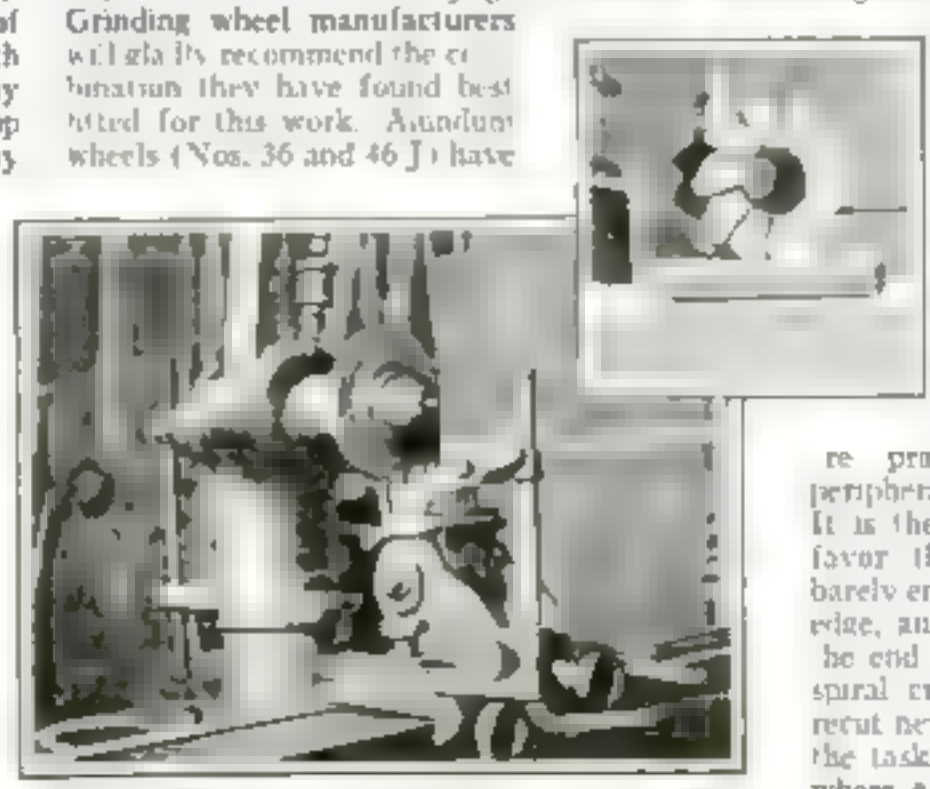
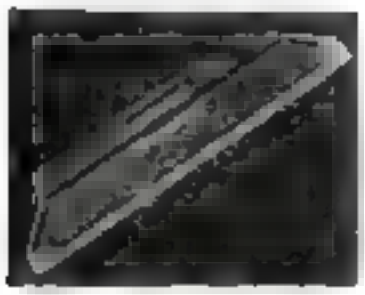


Fig. 1. Set-up for spacing operation in recutting end teeth on shell end mill. Insert: Mill after recutting

A tool that gets rather hard wear is the shell end mill. As it is of a type much stronger than the end mill, large breaks are not likely to occur, but the corners will chip off more or less. Indeed, the vital sections of either end mill or shell end mill are the corners; in four times out of five, the end teeth are practically gone while the peripheral teeth are in good shape. It is therefore advisable always to favor the diameter by removing barely enough stock to attain a sharp edge, and then finish the job from the end teeth. Nearly all mills are spiral cut, and it is a pleasure to recut new end teeth as compared to the task of recutting the periphery where a lead has to be generated

In the set-up shown in Fig. 1,

Taking the risk out of flying



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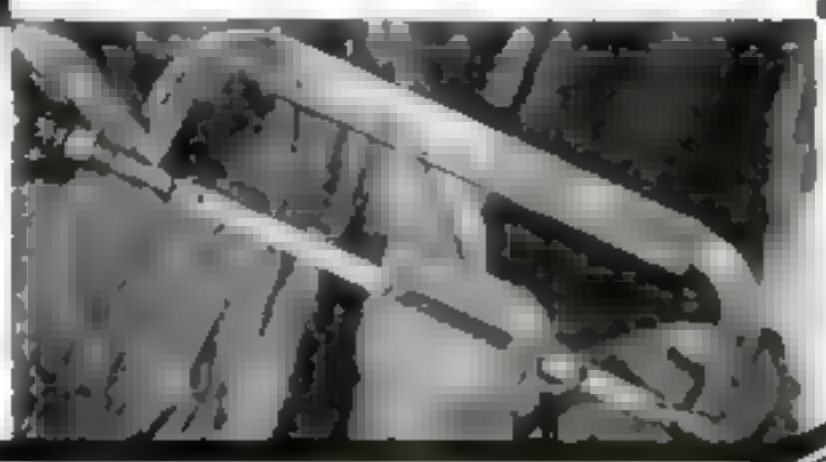

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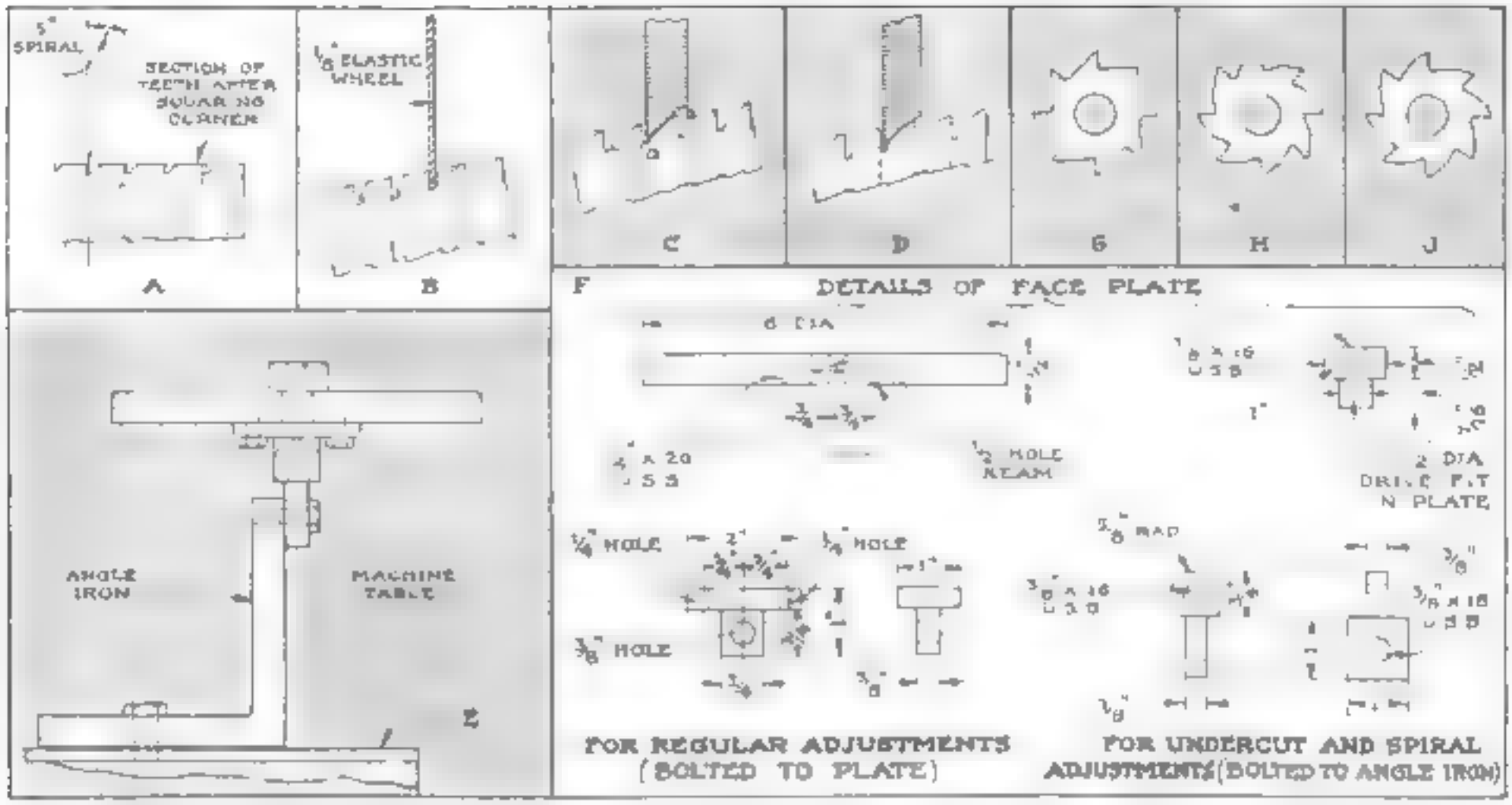


Fig. 2. *(A to D)* Steps in salvaging shell end mills. *(E)* A grinding fixture and *(F)* details of parts. *(G to J)* Three common shapes of teeth.

the original diameter of the shell end mill was 1 ⅛ in. Since all proper care had been given the peripheral teeth, the diameter had been reduced less than ¼ in., but the thickness had gone down from 2½ to 1⅛ in. because the end teeth had already been recut four times. It appeared that they would, however, stand at least two more similar operations. A shell end mill of this size and type costs about $15; the time required for salvaging the end teeth should not exceed 1½ hours.

As a first step in salvaging the counterbore must be reground deeper; this is easily done in the internal grinder with a 46 K wheel. The next operation is to resurface the mill until sharp corners are obtained all around as at *A*, Fig. 2. This may be done on the surface grinder or on centers in any other grinder, using the side of the wheel.

In order to recut end teeth on any cutter with spiral and undercut peripheral teeth, it is necessary to have some kind of fixture that can be set at the required angle horizontally and also at a right angle. It is not advisable to use a good milling fixture on a grinding machine because the emery dust will soon put anything of this sort out of commission, but the operator may devise his own means, or the fixture shown at *E*, Fig. 2, can be made cheaply and will prove useful.

After fastening the mill to the faceplate of the fixture and making the necessary adjustments to compensate for spiral and undercut, a 6 by ⅛ in. elastic wheel is mounted on the spindle and a cut from ¼ to ⅜ in. deep is taken at each index as illustrated at *B*, Fig. 2. The wheel is then changed to a 36 or a 46 J (the latter will give a better finish), and the angle is formed on the wheel, provided a plain tooth as shown at *G* is desired. The angle varies according to the depth and the size of the mill, it should naturally correspond to a line drawn from *a* to *b* in diagram *C* of Fig. 2.

The wheel should be from 3½ to 4 in. in diameter with a ¾-in. face. Each tooth is gradually finished at each index to within 1/32 in. from the cutting edge. If the adjustments to the cutter are correct, the grinding should come in line with the face of the tooth.

The insert in Fig. 1 shows the shell end mill after being recut.

The form shown at *D*, Fig. 2 is used extensively in cutters of the high-powered type, and a very rigid tooth is thus produced. The operation is the same as previously outlined except for changing the shape of the wheel. The diagrams *G*, *H*, and *J* show the three shapes of tooth in common use.

It is advisable when either making new shell end mills or buying them, to favor those with a plain hole instead of those with a recess. A through hole permits recutting the top teeth as long as the cutter will last.

Next comes the broken drill. No matter what care is taken drills are likely to break while drilling cheap castings. Small sizes, of course, may be reponted by hand. Large drills should be repaired as follows:

After cutting off the bad section with an elastic wheel, hand-rough the point as at *A*, Fig. 3, and solder on a brass tip as at *B*. The center is then located in the lathe by the usual method; namely, with the use of the center rest and a jig bushing to fit the drill. The average shop has an ample supply of bushings, and the one needed usually can be found. The center once located, the brass tip is removed and the point is reground with the tool-post grinder fitted with a 5 by ⅛ in. K wheel. The regular drill grinder is used for the finishing touch.

Next month Mr. Chamberland will discuss the salvaging of plain end mills, counterbores, side milling cutters, and reamers.

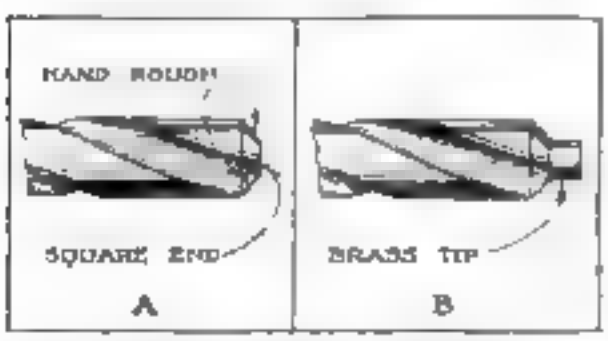


Fig. 3. The two steps in the preparation of a broken drill for the regrinding operation.

Old Bill *Says*—

SPIRALLY fluted taper pin reamers should never be run at a speed greater than two thirds of the proper speed for a drill of the same diameter.

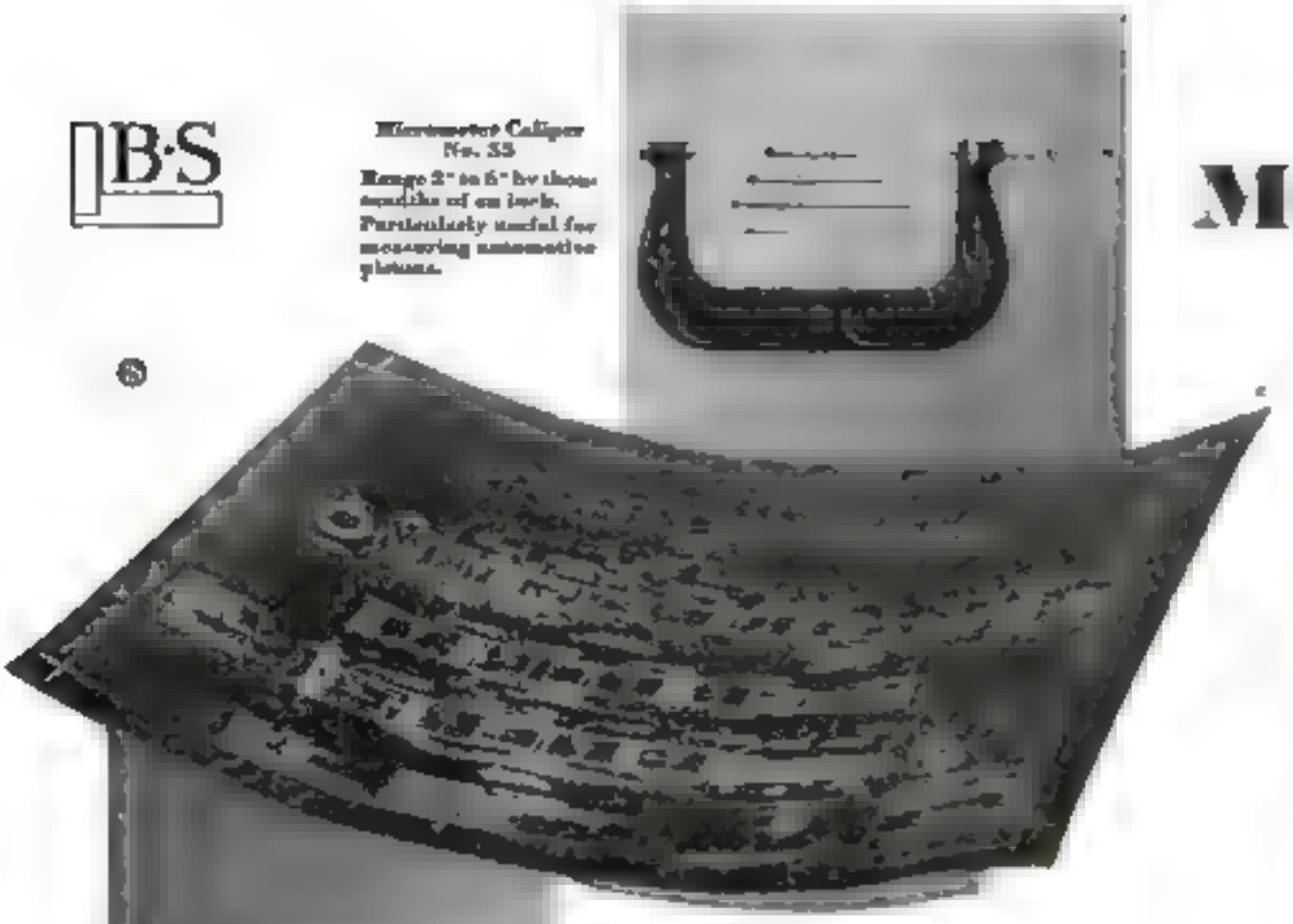
A discarded hack saw blade, ground to a knife edge and inserted in a hack saw frame, forms an excellent knife for cutting rubber.

Theory is valuable only when it facilitates practice.

Compound dies which require no clearance at the cutting edge should be convexed about .002 or .003 in. so as to counteract any bulging of the wall when the die is heat treated.

An arbor press is a good place to try out bending and forming dies.

B·S



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Six Machine Shop Timesavers

How to start taps, extend parallel clamps, and fasten down machinery—A center gage and a handy drill case

WHEN a machinist's parallel clamp will not open wide enough to take the work at hand, it sometimes can be made to serve by using with it one jaw and both screws from another similar clamp in the manner illustrated in Fig. 1

Open the complete clamp to its full extent, allowing the front screw to enter only halfway through the threaded hole in the jaw and then start the front screw of the single jaw into the other end of this same hole. The approximate distance needed between the jaws can be obtained by revolving the single jaw on the front screw and the final tightening adjustment can be made by turning the back screw of the single jaw up against the head of the back screw on the complete parallel clamp.—HARRY MOORE

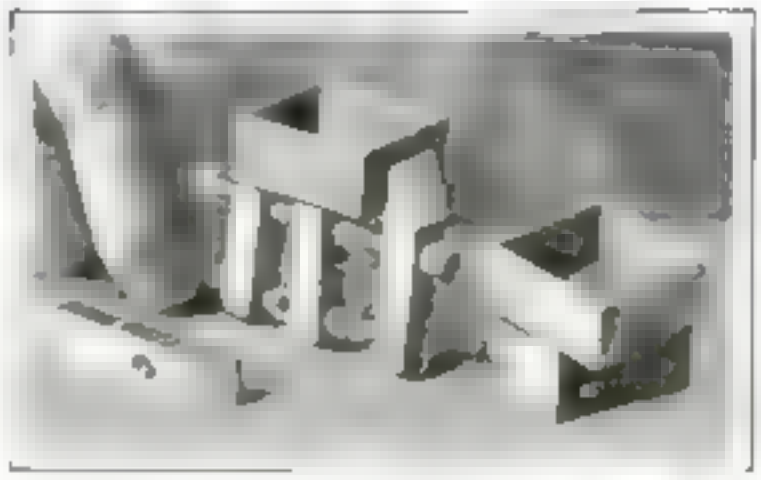

Fig. 1. How two parallel clamps can be used together in order to take extra wide work.

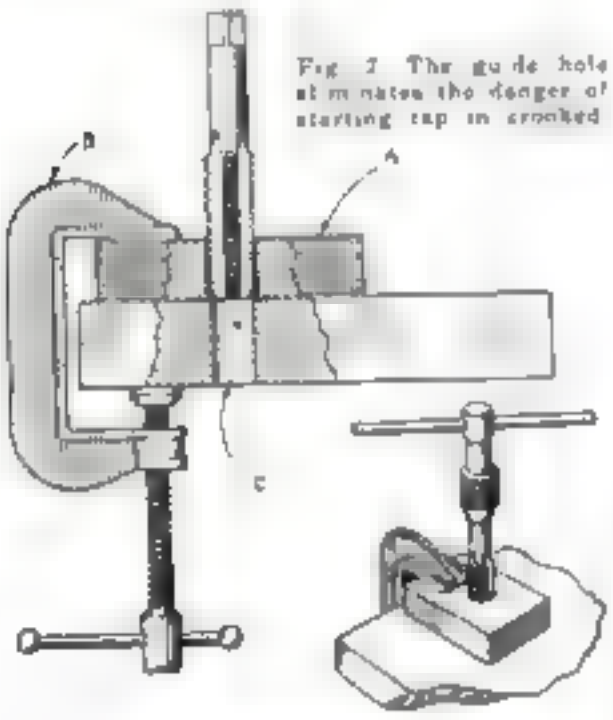

Fig. 2. The guide hole at A eliminates the danger of starting tap in crooked

STARTING TAPS STRAIGHT

BY THE application of the simple kink shown in Fig. 2, it is possible to eliminate any possibility of starting a tap crooked.

A piece of scrap material *A* is drilled to the body size of the tap. This is then centered over the hole *C* in the work and fastened in place with clamp *B*. The hole in *A* serves as a guide for the tap.

In work requiring taps as small as or smaller than 5/16 in., it is not necessary to clamp the guide piece in place, merely allow it to float on the surface of the work.—CLARENCE J. TURCOTTE

HOLDING DOWN MACHINES

A SIMPLE yet effective way to fasten machinery, benches, and other equipment to a concrete floor is to drill holes slightly larger than the diameter of the lag screws to be used and fill these holes with steel wool, packing it in tightly with a punch and hammer (see Fig. 3). When a lag screw is driven into the steel wool it will force the material out against the sides of the hole with great pressure. The writer has found that it is possible to twist off a ½-in. lag screw held by this method before it will slip

This same method also can be applied to brick and plaster.—CHARLES N. SCOTT

CENTER ALIGNMENT GAGE

A SIMPLE gage for testing the alignment of centers on a lathe can be made from a ¾ by 1 by 12 in. piece of scrap steel. Grind the stock square on all four faces and then drill, ream, and countersink each end of the hole as shown in Fig. 4

Fig. 4. A simple alignment gage for centers

In use, the gage is placed between the centers and the distance between the gage and the faceplate checked with calipers or gage blocks as the center gage is revolved to different positions. If the distances are not the same, it is an indication that the lathe centers are out of alignment.—F. J. WILHELM

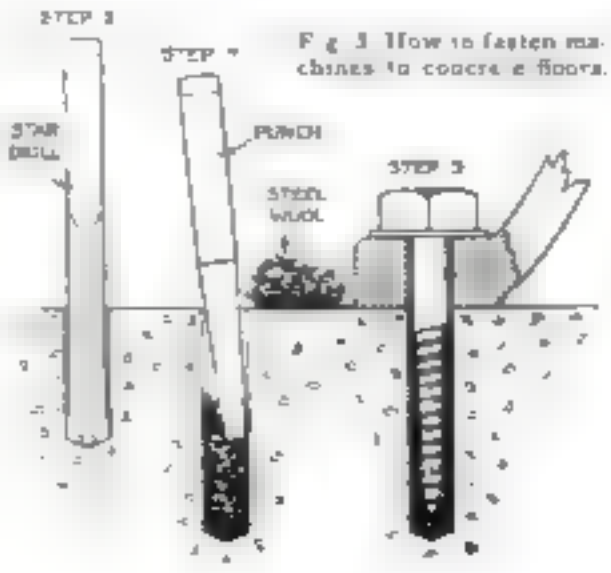

Fig. 3. How to fasten machines to concrete floors.

BESIDES making it possible to machine fillets without the usual chattering of the tool and the resulting rough finish, the gooseneck fillet cutter illustrated in Fig. 5 has a circular cutter bit that can be revolved in order to bring a new section of the edge into operation when one section becomes dull

The cutter holder is shaped from mild steel bar stock. The straight end of the bar should be left in the square form so that it can be held in the conventional type tool post. The cutter, which should be made from high-speed tool steel if the best results are to be obtained, is fastened to the holder by means of a cap screw.

Any chatter is eliminated by the spring of the gooseneck portion of the holder, and since the cutter bit cuts with a scraping action it is possible to obtain a smooth finish.

A set of cutters made to various diameters will take care of all such work in the shop, as it is a simple matter to remove one cutter and replace it with another.—CHARLES H. WILLEY.

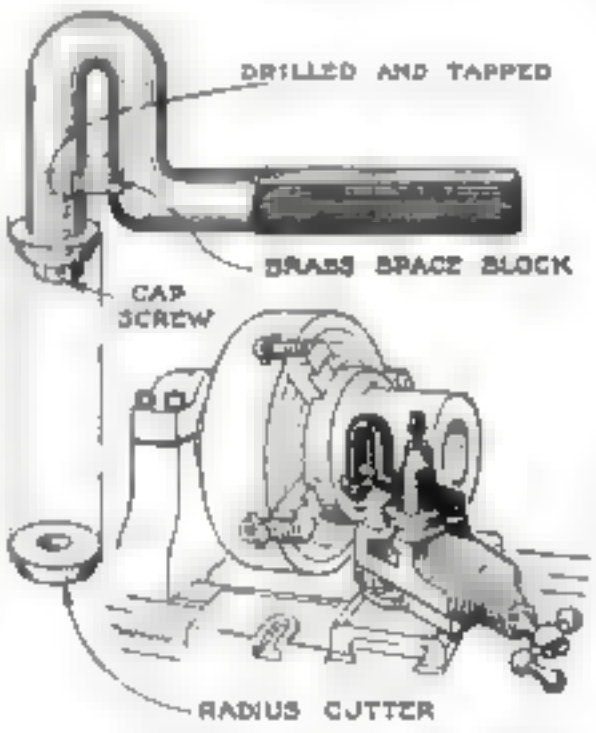

Fig. 5. Fillet cutter and gooseneck holder, and how they are used in machining rad I

DRILL AND TAP CASE

MECHANICS who find it necessary to carry a large assortment of taps and drills in their tool kits will find that convenient cases for them can be made from the various sizes of renewable type, screw cap electric fuses. Besides making it possible to label each case to facilitate rapid selection of the tools, these holders will serve to protect the drills and taps.

The link and connecting pieces in the fuse are removed, and a sheet copper or brass disk is soldered over the end of each cap. A good size of fuse for this use is the large 400-ampere type of cartridge.—CARL O. LANDRUM

Here's George La Moth, foreman of the Planer Dept. at the Cincinnati Planer Co., demonstrating the use of a Combination square that comes with every Lufkin Student set. He is squaring the clapper box on a 36" Planer. It must fit to within .0001 of an inch.

George Tells Them Why

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George again, examining the 6" Flexible Steel Rule which is a part of all Lufkin Student Sets.

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These student apprentices are traveling on the upgrade. Tomorrow they will be skilled machinists, men behind the scenes responsible for the accuracy of vital airplane parts, delicate surgical instruments and giant mechanisms for thundering locomotives. Tomorrow, their skill as mechanics and precision tool experts will be tested on that razor-edged measurement that often spells the difference between safety and disaster.

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A Better Way to Sprinkle Lawns

How to install an underground watering system that rivals rain in its efficiency

By B. M. BEEMAN

Underground sprinklers are growing in favor. Some of the more elaborate systems, costing as much as $15 a head, include an automatic clock mechanism which turns the water on and off

HOW often have you wished for an underground sprinkler system with which you could water your entire lawn by a turn of the wrist? A well-designed system of this kind is rain's only rival: it provides a fine mist that gathers on the bushes, flowers, and lawn like dew.

The installation of an underground system can be made to suit your pocketbook. The least expensive way—and the one to be described—is to make your own sprinkling heads and install the piping yourself. However, heads can be purchased for as little as a dollar each, and you can still do your own pipe work. The best time to make the installation, of course, is in the early spring.

The first step is to make a layout of your lawn such as that shown to determine the number of sprinkler heads. The heads are placed on about 15-ft. centers.

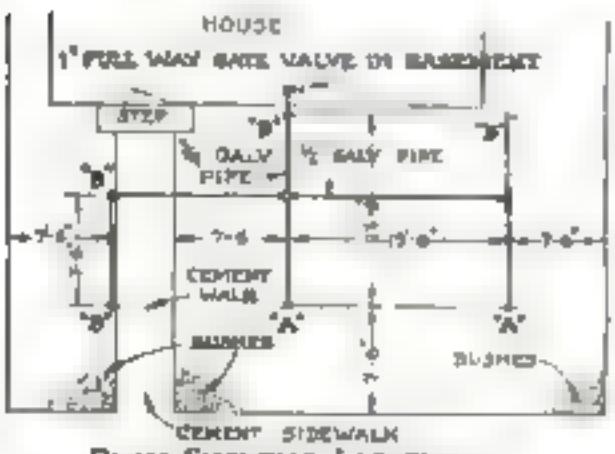
If you decide to make the sprinkler heads, the body part can be turned from 1¼-in. aluminum bar stock and the centers from suitable round brass stock. Chuck the aluminum bar in a lathe and turn the outlet hole to an angle of 38°, as shown. Then drill a hole through the stock for the brass center, and ream so as to be a very tight fit for the center. The head is now turned end for end and drilled as shown with a 49/64-in. drill, and tapped with a ½-in. pipe tap.

The brass stock for the centers is drilled out on the lathe and then cut to length after which the 3/16-in. holes are drilled through each way for the type "A" centers. In the case of the type "B" centers, which go along the edge of the sidewalk, two 3/16-in. holes are drilled at a 45° angle.

While the author has found this construction satisfactory, it is an improvement to make the centers of 3/16-in. brass and thread them to fit tapped holes in the aluminum heads as shown in the drawing marked "alternative construction." In tapping the heads, use a bottoming tap to thread right up to the shoulder.

Whether bought or made, the heads go on nipples from about 1 to 1½ in. long which are screwed into pipe lines of ½-in. galvanized pipe. You can obtain the piping from your plumber cut to length and do all the installation work with a couple of pipe wrenches. The pipe should slope slightly towards the valve to provide drainage and lessen the danger of freezing. The valve that regulates the system may be installed either indoors or outdoors.

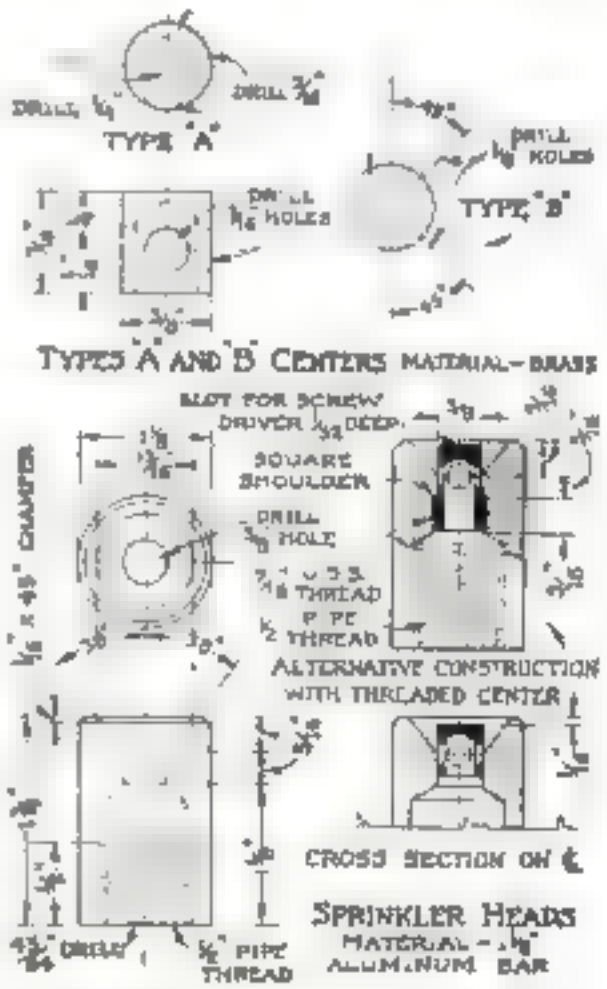
To place the system in the ground, dig a trench 6 or 8 in. deep and support the piping with brickbats or stones to hold it at the proper angle for drainage. Have the sprinkler heads flush with the surface of the ground.



PLAN SHOWING LOCATION OF SPRINKLER HEADS TYPES "A" AND "B"

PERSPECTIVE OF PART OF SYSTEM

The arrangement of piping and sprinkler heads used by Mr. Beeman on his own lawn.



Details of the sprinkler heads and two types of brass centers which are fitted into them.

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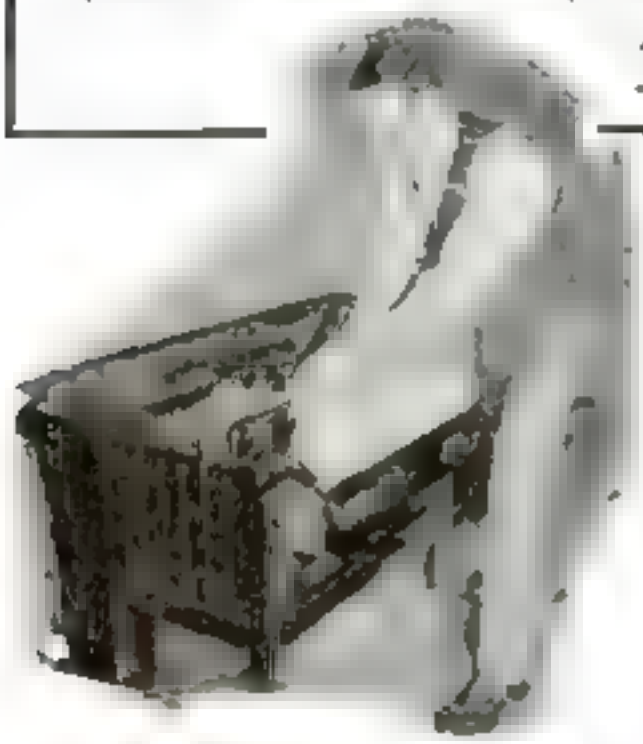

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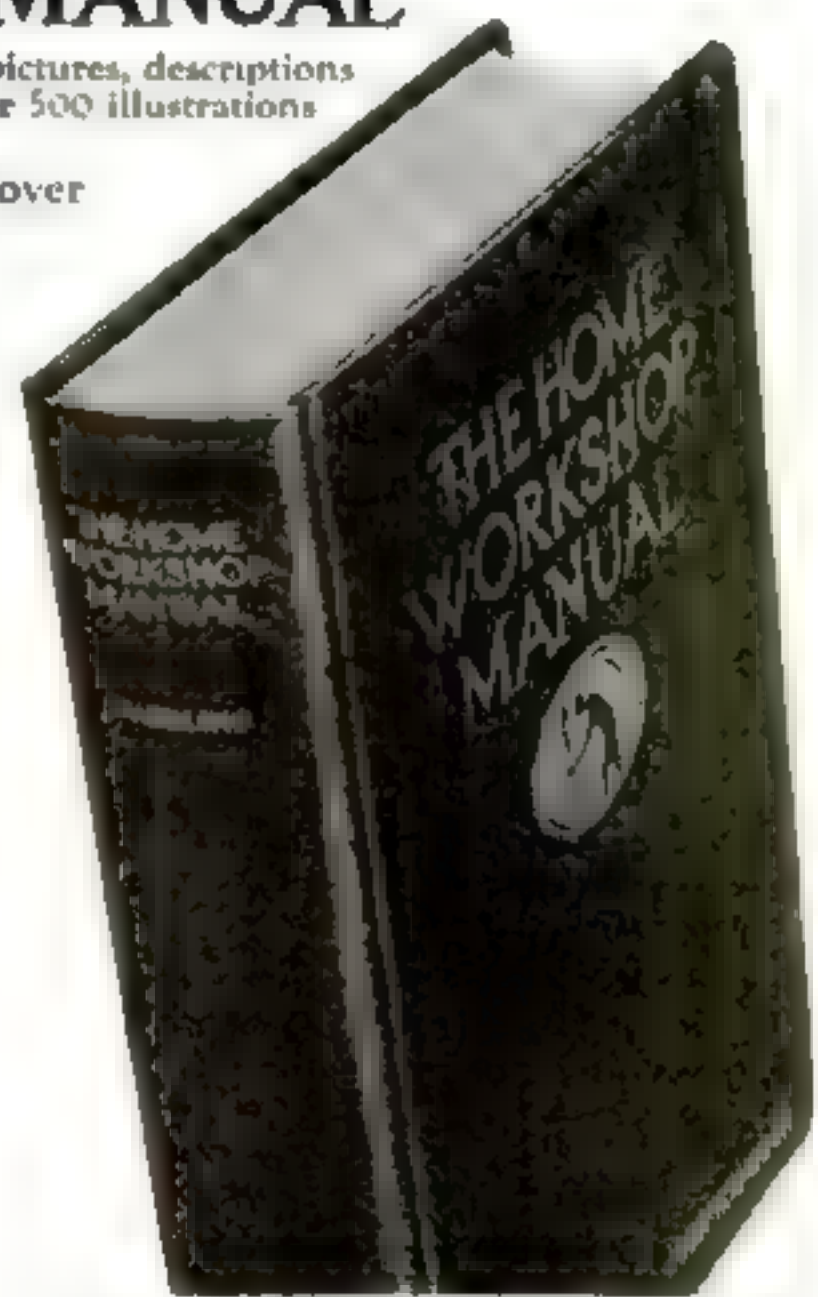

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What Floor Finish Shall I Use?

By BERTHA A. HOUCK

WHEN you are selecting the finish for your floor, three things must be taken into consideration—the type of room, the condition of the floor, and the kind of wood from which it is made. The more formal room ordinarily has stained and varnished floors, the exception to this being in a strictly "period" house. Colonial floors, for example, are frequently painted and decorated. Paint, furthermore, is appropriate for the floor of the cottage type of house where informality is expressed, and it is being used frequently in the modernistic house.

The kind of wood also indicates the manner of finishing. An expensive wood with a beautiful grain is usually given a natural finish of varnish to preserve and bring out its beauty. On the other hand, a cheap wood of unsatisfactory color and grain is generally stained and then varnished, or else painted.

Old floors in bad condition, no matter how they have been previously finished, should be refinished with paint if scars and ineradicable discolorations are to be covered up to the best advantage.

In choosing the paint or varnish to finish your floors, you will find that any standard brand will be satisfactory, providing it is made expressly for this purpose. Special products made for floor finishing are designed to resist hard wear and only these should be used under foot.

The question of what filler to use

The secret of having fine looking floors is to refinish them before they become badly worn

Chart Showing How to Finish Old and New Floors

SURFACE PREPARATION

New Floors	Finished Floors in Good Condition	Floors in Poor Condition
Open grain—Fill with paste wood filler Close grain—Use liquid filler or thin varnish Cracks—Fill with crack filler, or putty if floor is to be painted or enameled. When floor is to be stained, use a crack filler that will absorb the stain like wood If floors are to be painted or enameled—Apply a priming coat	Cleanse thoroughly; also sandpaper lightly if varnished or shellacked. If painted or enameled and to be given a natural finish—Remove old finish If varnished or shellacked and to be painted, enameled, or lacquered—Remove gloss by sandpapering lightly or washing with a weak solution of sal soda If varnished or shellacked and to be stained—Use paint and varnish remover If lacquered and to be stained—Use lacquer solvent to remove old coating If stained and to be painted or enameled—Coat with shellac or aluminum paint to prevent "bleeding"	Scrub with warm water and household ammonia (1 part ammonia to 6 parts water) and remove bad spots with spot remover, oxalic acid, or alcohol If badly discolored and to be varnished or stained—Bleach with a solution of oxalic acid crystals and hot water, using as many crystals as will dissolve readily. Apply solution with scrubbing brush and leave on surface until stains disappear; then wash off with clear hot water. Use care because the solution is poisonous
Finished Floors in Poor Condition		
Remove finish with paint and varnish remover; then sandpaper surface. (Open grain wood may need to be refilled with paste wood filler.)		

Note: When refinishing an old surface where paint remover has been used, a penetrating oil pigment stain or a penetrating aniline oil or spirit stain is needed.

METHODS OF FINISHING

	Paint and Enamel	Varnish	Water Stain	Oil Stain	Lacquer	Shellac
How to Apply	Stroke back and forth with brush	Flow on with full brush, do not go over a second time.	Apply with brush or sponge. If wood has open grain, fill with paste filler (colored to match). Then apply additional coats of stain as necessary	First brush on 3 parts turpentine to 1 part linseed oil. Apply paste wood filler, then oil stain. For close grain wood, apply clear liquid filler *after* staining	Apply with full brush across the grain, then brush lightly with grain, using a fairly dry brush. The room temperature must be at least 70° F.	Apply like varnish but work as quickly as possible and avoid laps.
Drying Time	Depends upon kind	2 or 3 hours.	Depends on how much is used. Allow ample time	12 hours.	48-72 hours between coats.	Several hours
Number of Coats	3 coats for new work. 1 or 2 coats for refinishing.	1 or 2 coats.	Several. Finish with 1 or 2 coats of varnish.	1 coat. Finish with 1 or 2 coats of varnish	2 or 3 coats on new work. 1 coat for refinishing	2 or 3 coats.

depends upon whether the wood is close or open grained, as will be seen from the accompanying chart. An important step, then, is to determine the kind of wood of which your floor is made. Most hard and close grained woods require no filler; the more common of these are ash, beech, birch, cherry, elm, and maple. The exception in this group is the Southern yellow pine or Georgia pine, which has a hard close grain but requires a liquid filler

The woods which have a soft, close grain and require a liquid filler are basswood, cedar, cypress, Douglas fir, larch poplar, redwood, spruce, sugar pine, Western yellow pine, white pine, and white fir Open grain woods require a paste filler, they include chestnut, mahogany, oak, and walnut

THE preparation of paste wood filler for use is very simple. It is merely thinned with turpentine to brushing consistency. Only as much filler should be mixed as may be used in one day, because the pigment settles to the bottom and some of the solvents evaporate. A brushing test should be made to try the consistency of the mixture. While the filler is being used, it must be stirred every few minutes. It is first brushed across the grain with an old, stiff brush. If it sets too rapidly, the surface may be wiped over with a thinner. After the filler has set for about thirty minutes, the excess is removed with excelsior or burlap, wiping *across* the grain. Paste wood fillers of the oil type should be allowed to dry for at least twelve hours. When completely dry the surface is sandpapered with No. ½ paper and wiped clean with a cloth dampened in benzine.

Liquid filler is applied with a brush in the same way as varnish. While prepared liquid fillers are available, it is usually satisfactory to use varnish thinned with turpentine for this purpose

Not only do new wood floors have to be filled, but old ones frequently require refilling if their finish has been removed with a paint and varnish remover

THE remover is applied with a brush. When the finish softens, it is scraped off with a putty knife or scraper The surface then should be washed with cotton waste or a cloth soaked in thinner (benzine or turpentine) to remove the wax left by the paint and varnish remover

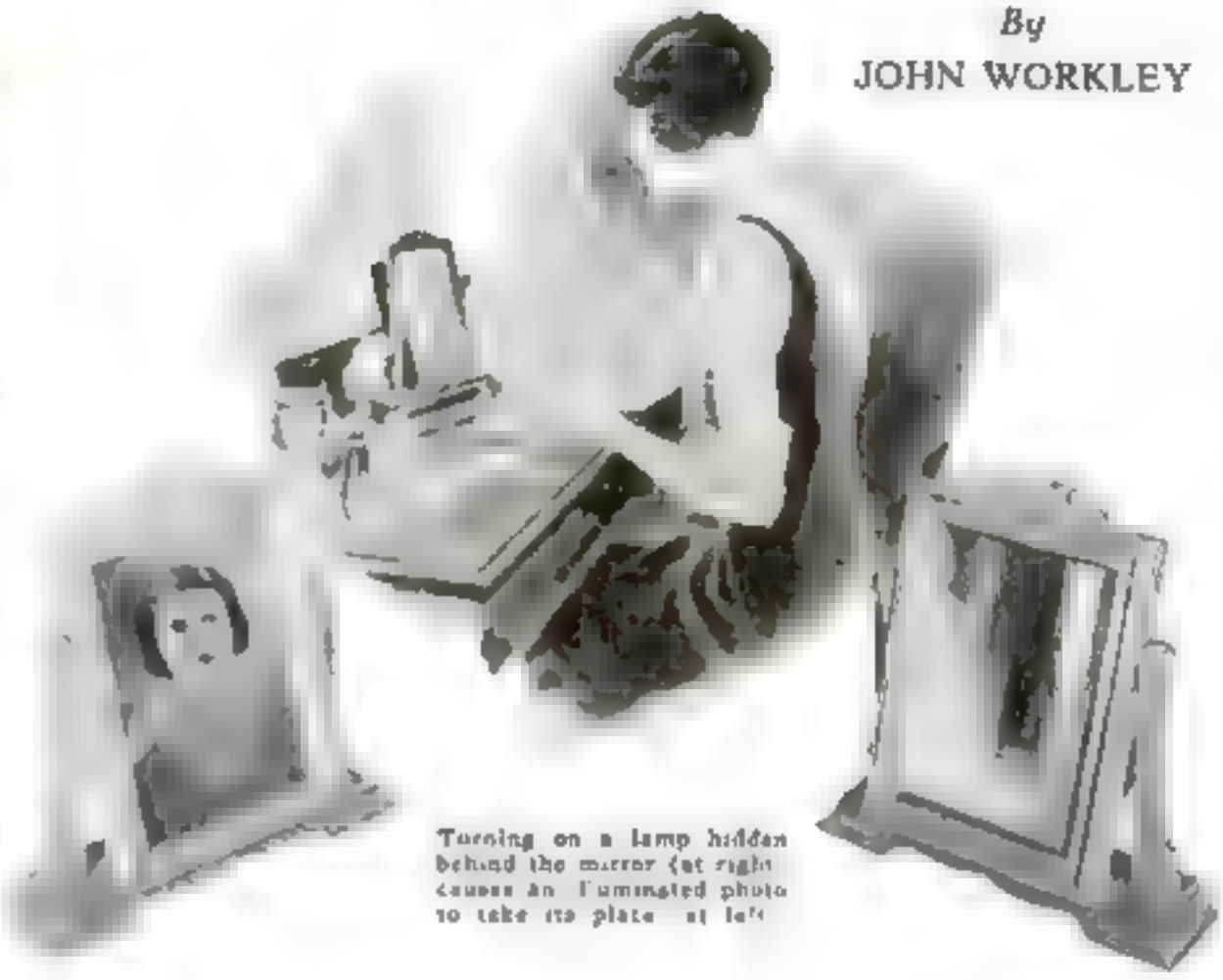
Soap or soap powder should never be used on a floor that is to be finished. An old unfinished surface should be cleaned according to the directions in the accompanying chart; and a finished surface, if in good condition, should be washed with gasoline or benzine before refinishing By "good condition" is meant a finish which shows merely normal wear

Floors that have been waxed or oiled must have these materials completely removed with turpentine or other paint thinner before they are finished with paint or varnish.

When a floor is to be lacquered (of course, with a special floor lacquer), the lacquer should be "flowed" on with a full brush, and it will smooth itself out. In case it fails to do so, it may be gone over quickly with a brush that has been dipped in a little lacquer thinner.

This Mirror Turns Magically into a Lighted Photo

By JOHN WORKLEY



Turning on a lamp hidden behind the mirror (at right) causes an illuminated photo to take its place at left

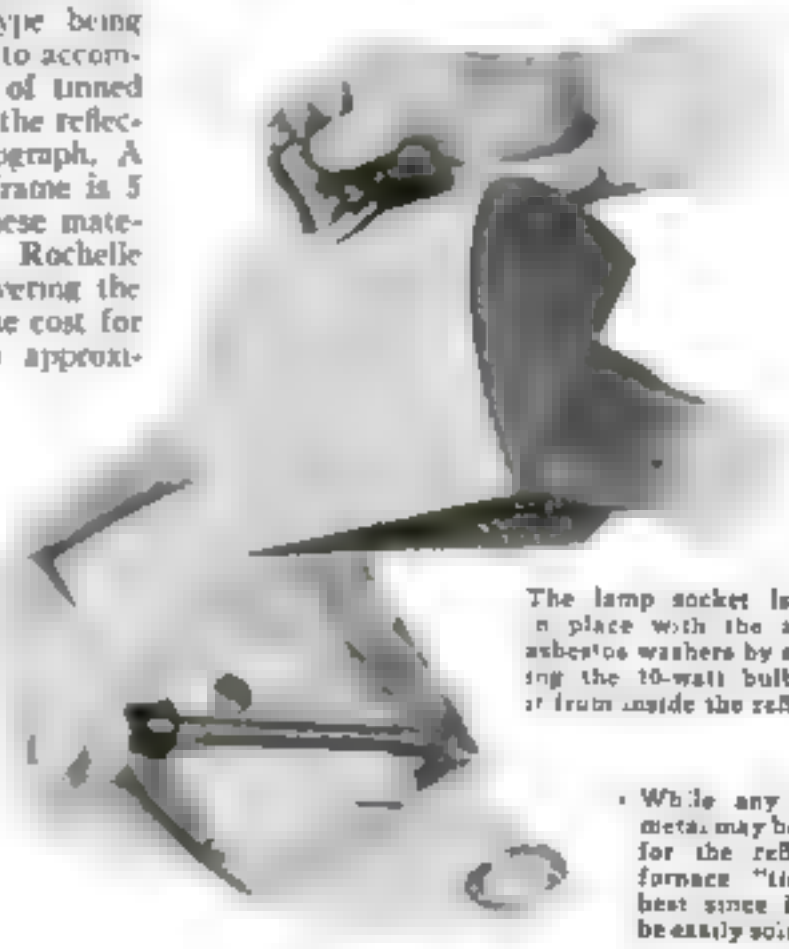
TO ALL appearances, this mirror is nothing out of the ordinary, it reflects your face like any other glass. But turn on the electric light concealed at the back, and it is no longer a mirror. Instead, it is a photograph beautifully illumined by the soft radiance from behind.

To make a mirror-picture of this type involves no great degree of skill. The materials you will need are a swinging picture frame one that turns on either a vertical or a horizontal axis an additional sheet of glass for it a small electric lamp, the 10-watt S-11 type being preferable; a pigtail socket to accommodate the lamp, a piece of tinned sheet iron or aluminum for the reflector; and, of course, a photograph. A good size for the picture frame is 5 by 7 in. In addition to these materials, some silver nitrate, Rochelle salts, and ammonia for silvering the mirror will be required. The cost for the materials amounts to approximately two dollars.

From the sheet metal construct a reflector of a shape similar to that shown in the photographs. The distance from the rear center of the reflector to the glass of the frame is from 2½ to 3 in.

Although aluminum is an excellent reflector, furnace "tin" is more easily worked because it can be soldered. Cut three pieces, one rectangular in shape for the back and two sidepieces with curved edges. In the center of the back, punch a hole slightly larger in diameter than the threaded base of the lamp bulb. Then, when assembling, merely thrust the base through the hole and screw it into the socket using if necessary, asbestos washers for padding. No other fastening is required. Paint the outside of the metal some suitable color.

The photograph, for best results, should be a positive transparency made by direct contact with the negative on either a plate



The lamp socket is held in place with the aid of asbestos washers by screwing the 10-watt bulb into it from inside the reflector

While any sheet metal may be used for the reflector furnace "tin" is best since it can be easily soldered.

or cut film. However, a print is satisfactory if made on thin paper and treated with clear varnish to increase its transparency. If a print is used, give several times as much exposure as normally would be required in printing and develop fully.

Silvering the mirror is simple, if you observe the rules, particularly those of cleanliness, and always use distilled water. Make two solutions, as follows:

No. 1. Heat 4 ounces of distilled water to the boiling point, add 3 grains of silver nitrate and 3 grains of Rochelle salts, and boil for 8 minutes. Cool and filter through cotton or filter paper, using a glass or rubber funnel.

No. 2. Into a tablespoonful of distilled water place 5 grains of silver nitrate and agitate until dissolved. The solution may be slightly cloudy. Add ammonia water, drop by drop, until the solution becomes muddy, then clears. Next add 4 grains

The reflector can be made to fit snugly inside the rabbeted-out recess of the frame

more of silver nitrate, dissolve, and add distilled water to make 4 ounces. Filter as with solution No. 1.

It is better to let these solutions stand overnight before using. Wash the glass thoroughly with soap and water, rinse in clear water, swab with a wad of cotton dipped in ammonia water, and rinse in distilled water. Do not allow the glass to become dry and do not touch the surface to be silvered.

On a block of wood or a cardboard box slightly smaller than the piece of glass, place a piece of newspaper. Lay the glass on this so that the lettering is clearly readable everywhere. Level the glass. It is advisable, although not essential, to arrange it in a tray or pan so that any spilled solution will be caught.

Thoroughly mix equal parts of solutions Nos. 1 and 2, and immediately pour the mixture on the glass. The liquid should flow to all edges. Watch the glass and when the lettering on the piece of newspaper is just barely visible beneath the silver film, pour off the excess solution, rinse the delicate silver coating in clear water, and dry.

If the silvering is sufficient, spray a coat of lacquer or clear varnish over the silver film, and the mirror is ready to use. Further silvering, if necessary, can be done by repeating the process.

Place the mirror in the frame, the picture behind it, and a sheet of clear glass at the rear, and fasten them in the usual manner with brads or old phonograph needles. Then add the reflector and lamp, and the picture mirror is complete.

BLUEPRINTS FOR YOUR HOME WORKSHOP

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. Each subject can be obtained for 25 cents with the exception of certain designs that require two or three sheets of blueprints and are accordingly 50 or 75 cents as noted below. The blueprints are each 15 by 22 in.

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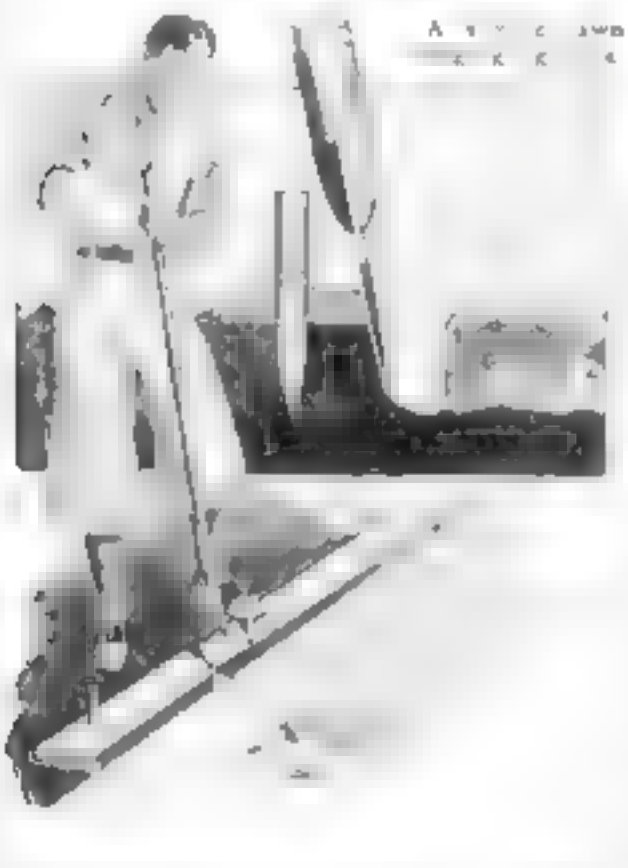
WOODEN GUIDE AIDS IN EDGING GRASS PLOTS

WHEN the edge of a lawn is to be trimmed along a sidewalk or driveway it is common practice to stretch a rope to serve as a guide. A better method is to use a board 10 or 12 ft. long, as illustrated. This is prepared by snapping a chalk line along one edge and planing it straight. Then two holes ¾ in. in diameter are bored in the board so that sharpened pegs 10 in. long can be driven



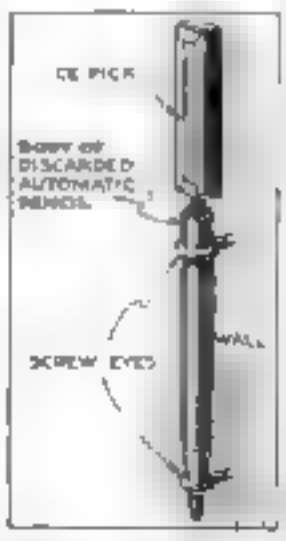
through them into the lawn for a depth of about 3 in. to keep the guide in place. Two strips nailed on each end of the guide serve as gages to keep the straightedge a uniform distance away from the edge of the walk.

A slight bevel on the front edge of the guide makes the cutting easier. In the absence of a regular edger or cutter a large kitchen knife will serve the purpose.—ROBERT W. MEISER

NEAT ICE PICK HOLDER MADE FROM PENCIL

THE discarded shell or body of a mechanical lead pencil will serve as a holder for a small ice pick. It may be attached to the wall in any convenient position near the refrigerator by means of two screw eyes, one large enough to slip over the body and the other of a size to fit the tapered nose about halfway up.

Both the holder and the ice pick handle may be lacquered to harmonize with the color scheme of the room if you so desire.—F. J. WILHELM



How the holder for an ice pick is made

WITH a bell transformer, it is best to use a bell designed for A. C. operation

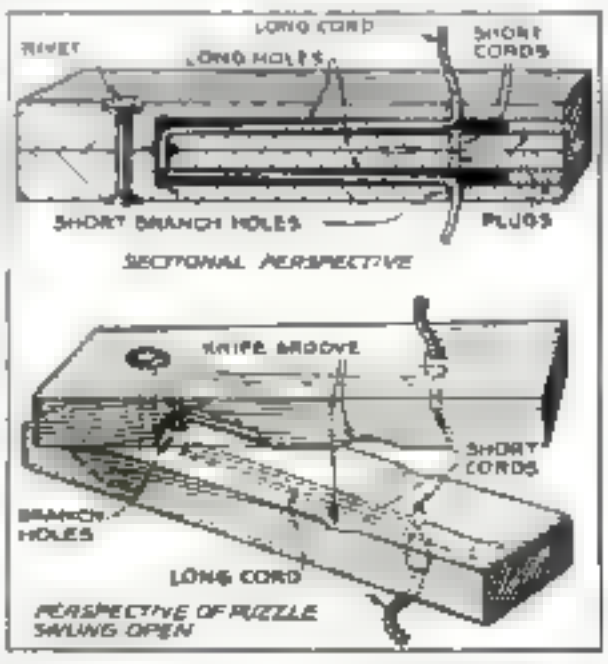
HOW TO MAKE A SIMPLE CUT-STRING PUZZLE

SIMPLE as it is to make, the trick or puzzle illustrated is quite deceiving and can be passed around for inspection. First, you show the blocks of wood closed and pull the string back and forth to demonstrate that it is a continuous length. Then you ask someone to run the blade of a penknife between the blocks so as to cut the string. To show that the string actually has been cut, you open the two pieces

When the string has been cut, a few magic words seemingly restore it to one piece.

of wood and point to the cut ends. Finally, closing the blocks again, you say a few magic words, whereupon the string is restored, for you are able to pull it back and forth just as at first!

To make the puzzle, two pieces of wood ⅜ by ¾ by 3¾ in. are needed. Drill a centrally located ⅛-in. hole, 2⅛ in. deep from the top of each piece; then drill a ⅛-in. hole through from face to face ¾ in. from the top of each piece. Also drill holes from the inside face of each piece to meet the lower end of the ⅛-in. hole. Fasten the blocks together with a small bolt or rivet. Thread a piece of string through the holes and tie a knot at each end. Then glue short ends of the same string in the holes in the inside faces, and glue plugs in the ⅛-in. holes in the top edges to hide them.—RICHARD L. GRAVES.

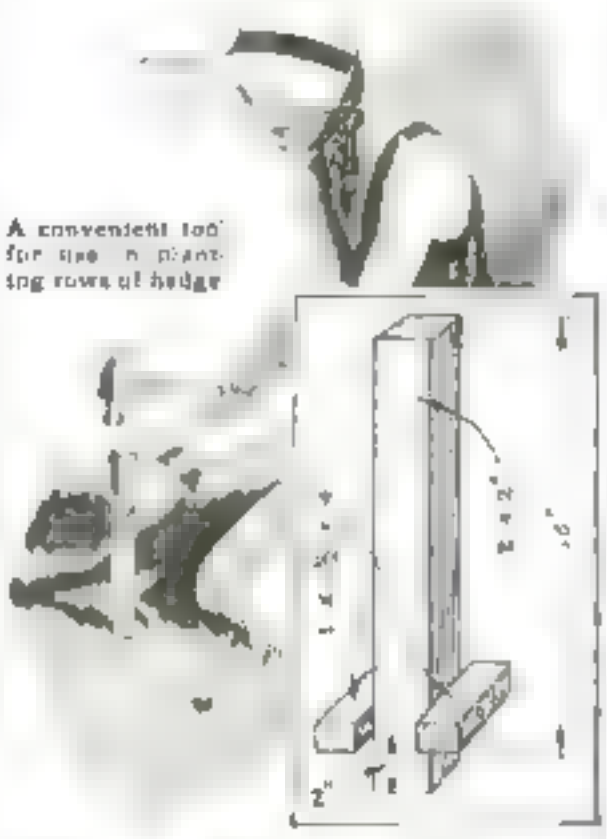


How the puzzle is made. Note bits of string glued in holes in inside faces of blocks.

PUNCH AND GAGE FOR PLANTING HEDGES

THE plant-hole punch, depth gage, and spacer illustrated is a timesaving tool for setting out a number of small plants such as required for a hedge. It is merely a piece of wood 2 by 2 by 16 in. with two guides nailed on the sides 2 or 3 in. from the end to gage the depth of the holes

Hedge plants are sold in lots of 100 to the "flat." The earth around each plant



A convenient tool for use in planting rows of hedge

is sliced into squares about 1¾ by 1¾ in., a size which will drop easily into the holes made by using the punch. The guides insure the proper depth of hole

When planting the hedge, work up the strip of earth which is to receive the plants, smooth it off, and run a guide cord to insure having a perfectly straight line. Then make the holes by hammering in the punch and space them uniformly by using the length of the punch—16 in. —as a guide.—E. MOFFAT

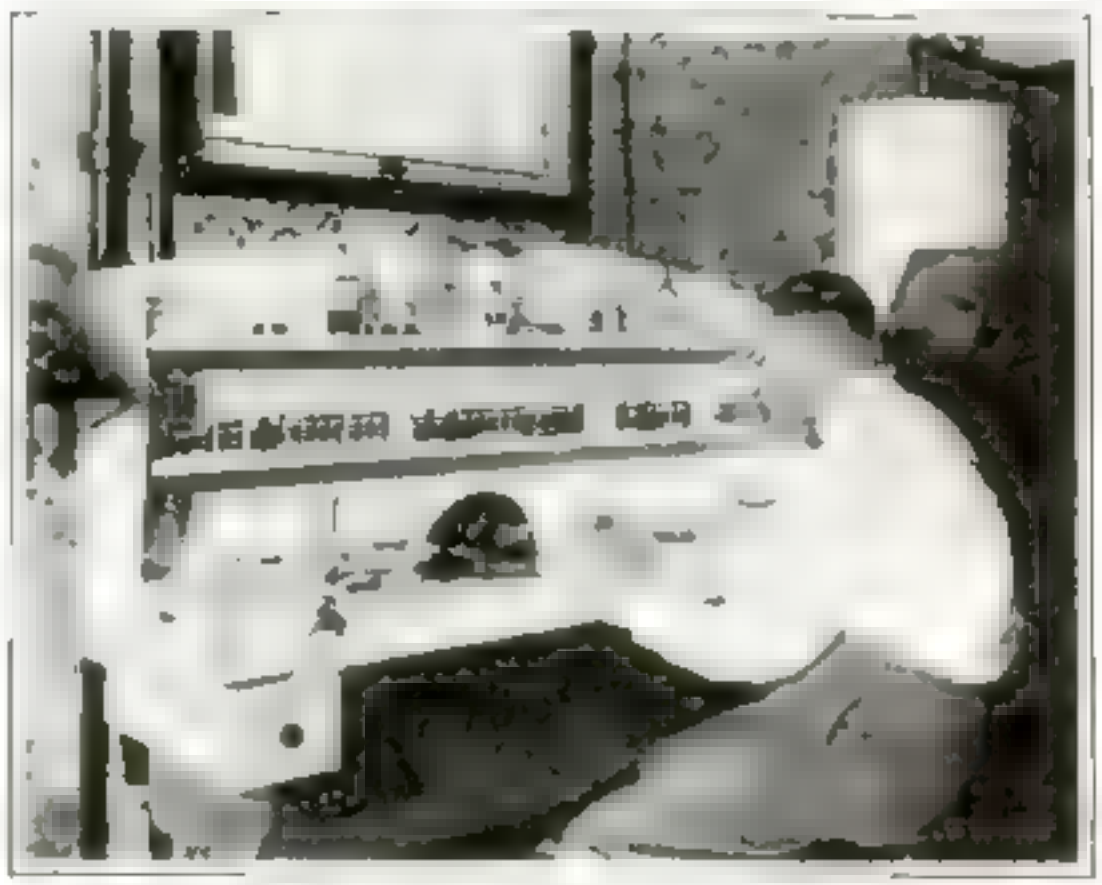
HINTS ON REPAINTING OLD GOLF BALLS

WHILE repainted golf balls may not be as lively as new ones, many golfers find them good enough for practice.

First, the balls must be thoroughly cleaned by scrubbing them with a stiff brush in warm water and soap. In applying the enamel, which should be the special golf ball enamel obtainable at sporting goods stores, pour a small amount into the palm of the left hand, place the ball in it, and place the right hand over the ball The right hand is then rotated, causing the ball to roll around in the enamel. By widening the arc of rotation it is possible to apply a thin, even coat to the entire surface

While this may seem to be a messy process, you will find that the wet enamel washes off quite easily from the hands and, of course, rubber gloves may be used if desired.

For drying, each ball can be supported on the points of three brads driven up through a piece of thin wood or cardboard to form a small triangle.—G. W



Chemical experimenting at home is doubly enjoyable if a convenient table such as this is constructed. It is set up on stationary washtubs in the basement.

Home Chemistry Table Rests *upon* Stationary Tubs

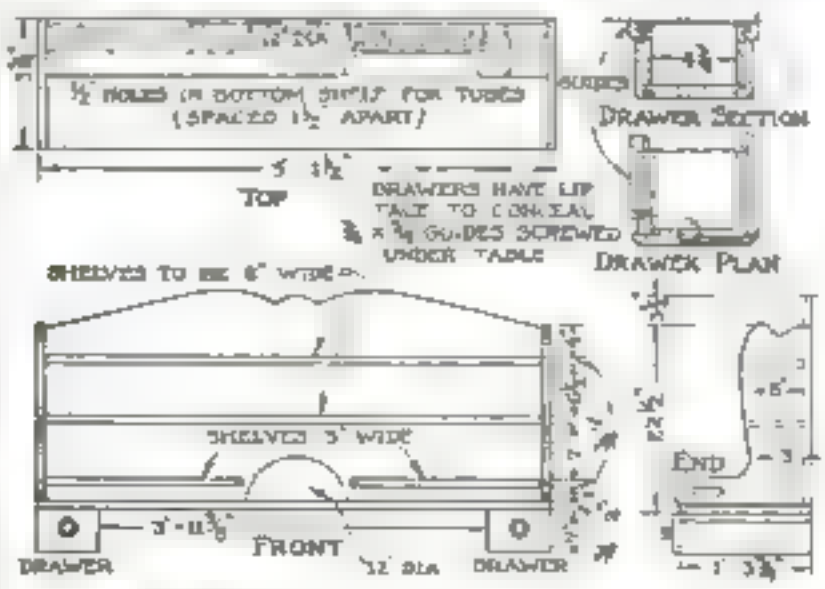
MANY readers of POPULAR SCIENCE MONTHLY, judging from my own experience, would take up the useful and most entertaining subject of home chemistry as a hobby if only they had a convenient place to work and do their experimenting. In my own case, the problem of arranging for a suitable table near running water kept me from entering into this work in the way I desired for three or four years. I found that there are many good tables or deskike cabinets on the market, but none of them seemed to fit into the space I had available.

I finally solved this problem by having a chemistry table made that resembles the top part of a desk. It fits snugly over the two stationary washtubs in the basement, as illustrated above.

The table consists of the main work board, a shelf with holes for test tubes and two shelves for bottles and other equipment. There is also a drawer under the table at each side for odds and ends.

Note particularly the semicircles cut in the center of the tabe top and in the back; these allow ample room for using the running water, the faucets being directly in front of the 24-in. stool upon which I sit.

The top and shelves are ⅞-in. clear white pine, and the ends and back are ¼-in. plywood panels. The drawers, which are of pine, have conventional lipped fronts and are supported by L-shaped guides or runs, screwed under the tabe top. The drawer sides are grooved to receive the guides.—J. L. KINMAN



The dimensions of Mr. Kinman's table. Where tubs are not available, a similar deskline top could be built with legs.

SMALL SANDING DISKS SHAPE MODEL PARTS

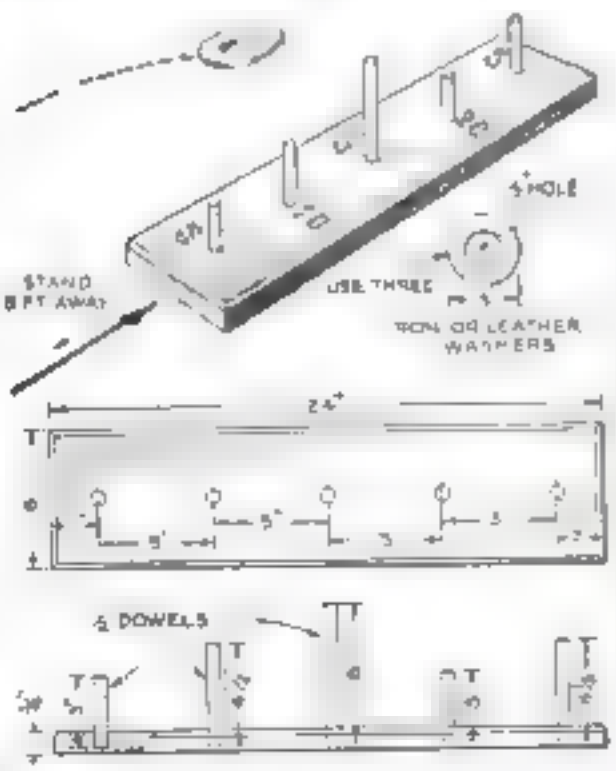
FOR the delicate shaping of model parts, small sanding disks often can be used to advantage. For example, the spokes of the covered wagon model shown in POPULAR SCIENCE MONTHLY Blueprints Nos. 118, 119, and 120 (see page 110) require arc-shaped depressions or "flats" to be formed just outside the hub line. On my model I made these with a ¼ in. thick wooden disk of suitable diameter, to the edge of which a strip of sandpaper was fastened. The wooden disk was then mounted on a ¼-in. spindle and set up in a drill press, and a simple wooden jig was clamped to the table so that the outer tip of each spoke blank could be placed in a notch and the butt end swung against the sanding wheel.—HARRY F. LOWE.

Ring-the-Peg Game Is Easy to Build

At a distance of 8 ft., the players attempt to ring the various pegs

HERE is a little game that will amuse any small boy. It is so simple that he can make it himself in less than two hours since all that consists of are five wooden pegs or dowels of various lengths set into a base 6 by 6 by 24 in. The pegs are spaced as shown in the drawings and set into the base 3/4 in. Color the base yellow, the pegs red and the numbers black. Three large metal or leather washers will serve as the rings.

Any number of children can play the game. The players should stand about 8 ft. away from the first peg and toss the rings so that they travel in a high arc. Forty is the winning total, and a player who is a good shot can win the game in but two throws if he can clear the third peg and ring the fourth.—D. W. C.



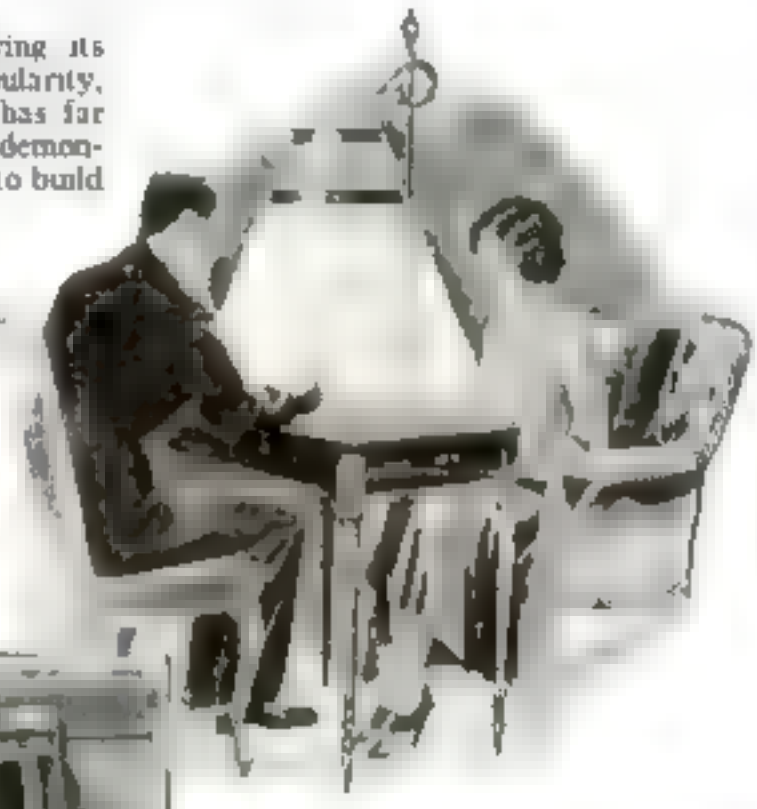
Scrap wood, dowel rod, and washers are all the materials needed for the construction.

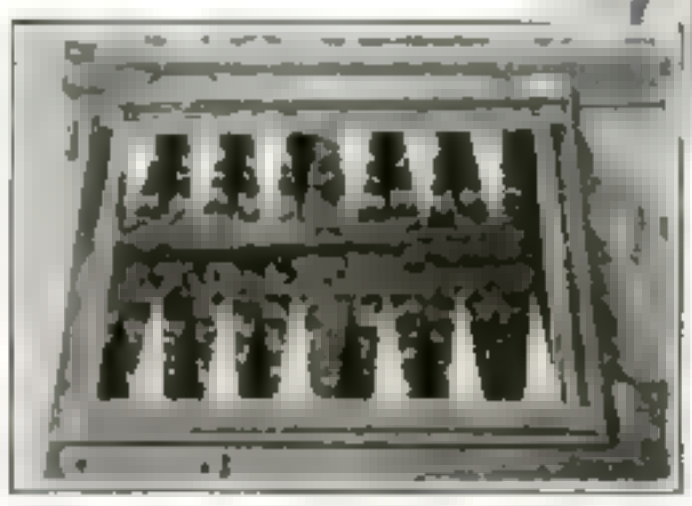
Building a Backgammon Table Fit for Championship Play

By R. EUGENE DOWNER

WITH backgammon enjoying its present extraordinary popularity, no amateur woodworker has far to look for a project upon which to demonstrate his skill. All he has to do is to build an inlaid backgammon table. While not an especially difficult task it will reward him with more favorable comments and reflect greater credit upon his craftsmanship than almost any other piece of furniture he could construct.

The table illustrated has been designed so that it can be made either by hand or with the aid of small home workshop machines. If a lathe is not available, the legs may be tapered and given a simple spade foot.



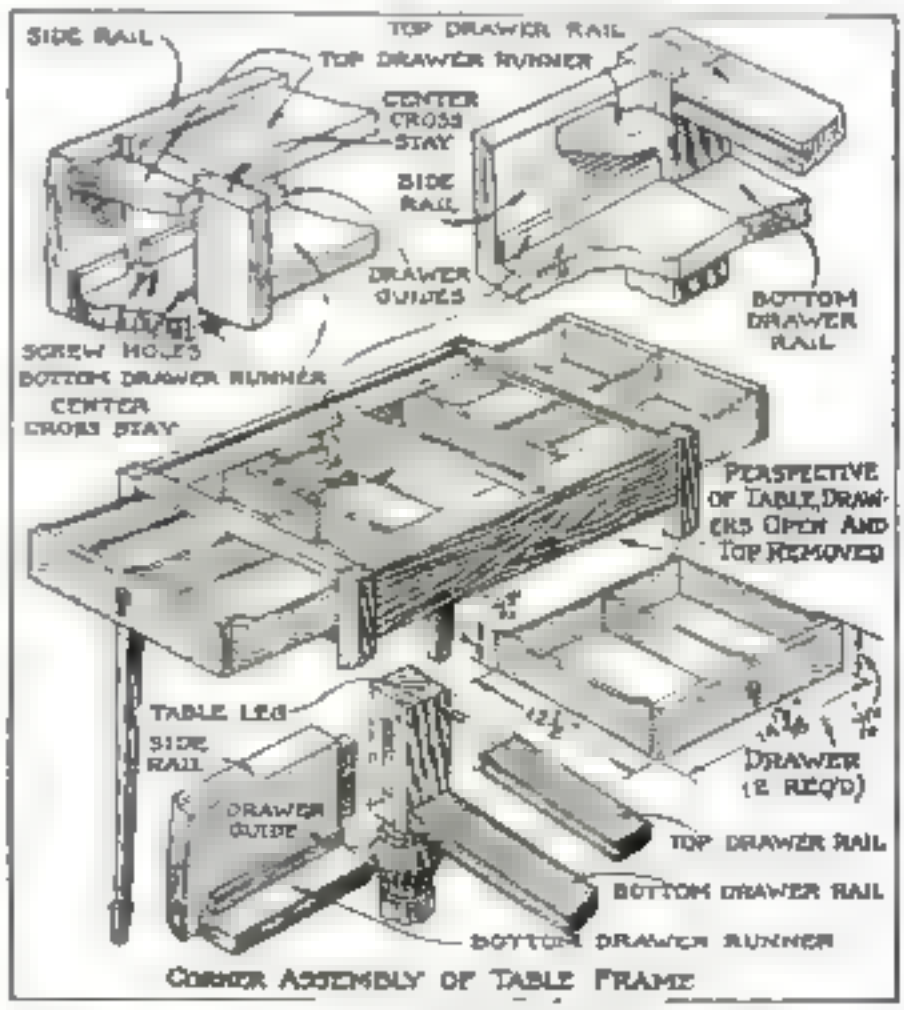


Although fifty pieces of wood are inlaid in the playing surface, the work is not difficult to do.

The method of making the board itself is not orthodox inlay, but it gives the same effect and is simple to do. Twenty-four triangular pieces called "points" are required for the gaming surface, twelve black and twelve white. For making them you will need 1 sq. ft. each of white holly and black ebony of the Gabon variety. The spaces between the points require 4 sq. ft. of a wood of contrasting color such as bubinga. This is a very hard, finely textured, and beautifully figured wood that finishes a rich wine color. All three woods should be ⅝ in. thick.

Ebony rarely can be obtained in pieces wider than 5 in.; yet inasmuch as it has no visible grain, one can cut a strip of it into 5⅞-in. lengths and from these saw out the points to the required size.

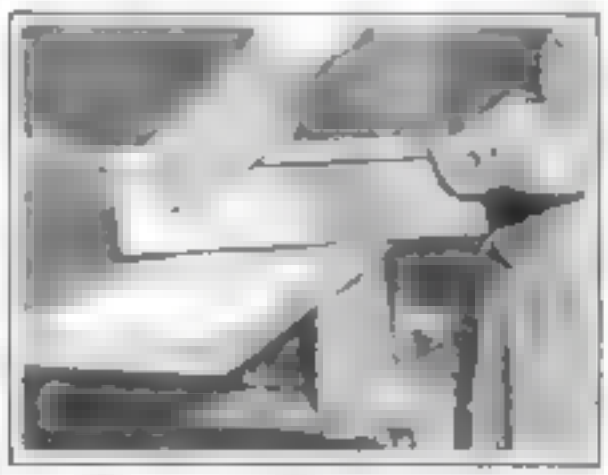
How to cut the points accurately and quickly on a small saw table is shown in a drawing on page 118. The crosscut guide is set at an angle of 75½° with the blade, and the



Perspective of the table without the top, and details showing the construction of the corner joints, drawers, and rail assemblies.

ripping fence is set 1¾ in. from the near face of the blade so as to act as a stop. By changing the setting of the ripping fence the inlets are cut in the same manner. If you have no power saw the points and inlets may be cut in a miter box.

For the core or groundwork, rip two straight well-seasoned pieces from 1 × 16 in. thick red gum to a length of 24 in. and a width of 5¾ in. and a single piece to the same length but only 3 in. wide. Roughen one face of each piece with a



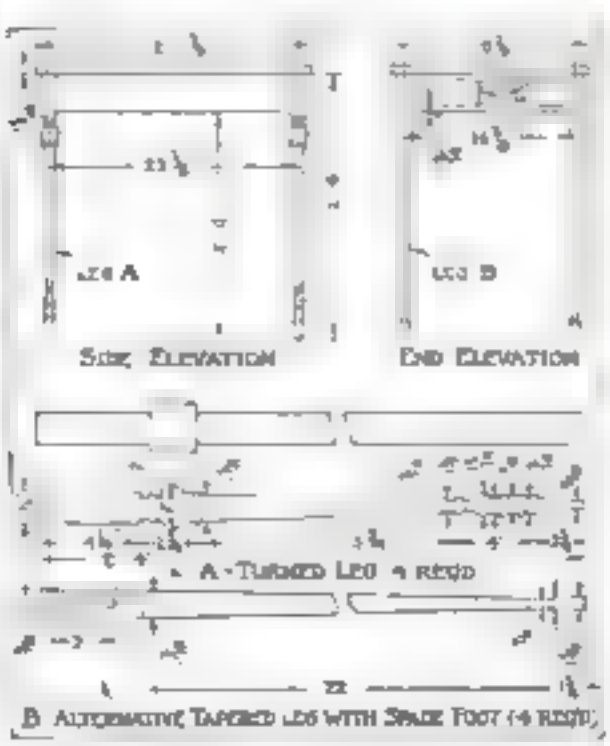
Roughing or "toothing" the core surface before gluing the points and fillets in place.

backsaw held as shown in the photograph above to give the glue a better grip.

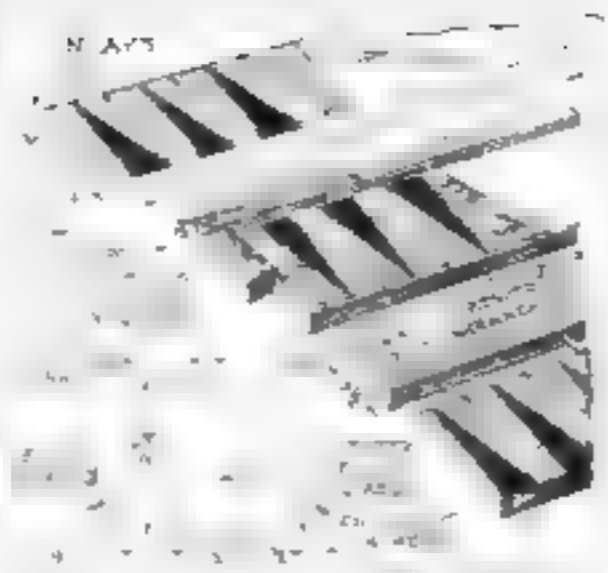
Before gluing, note that the black points are directly opposite the white and that the wide center fillets divide the board into four divisions of six points each, leaving space at the center for the crosspiece or "bar," which is preferably bubinga but may be mahogany.

The strips framing the playing surface are 1 × 16 by 2 in. selected mahogany rabbeted 1 16 by 9 16 in. on one edge. The groove for the holly inlay may be cut with the dado head to a depth of ⅛ in. before gluing the pieces to the board, unless an electric router is available. If you are dependent upon hand tools alone leave the strips plain. Glue them to the edges of the board, longuing the mitered ends as shown. Plane the edges square, sand the surface smooth, and give the mahogany a rubbing with linseed oil, then fill it with a paste filler slightly colored with a few drops of brown mahogany oil stain.

The legs are of zebrawood, which is of a light yellowish color with uniform dark



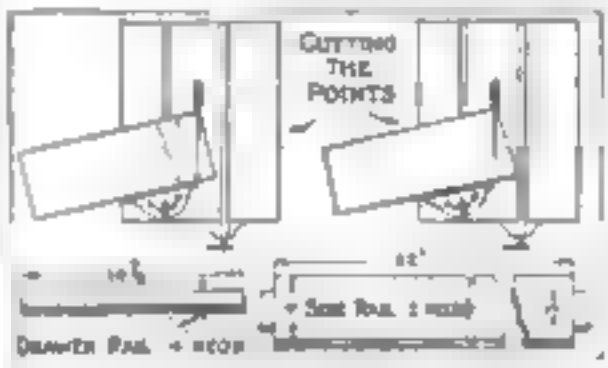
Drawings of the assembled table and the two different types of legs which can be used.



How the fifty pieces of wood are used in constructing the inlaid playing surface.

streaks. The side rails are of carefully selected mahogany. Before being assembled, they are stained with brown mahogany stain and rubbed quickly to bring out the figure; then they are allowed to dry and are given a thin coat of shellac. The table is finished with rubbed varnish

Mr. Downer has prepared more detailed instructions for those who have had little experience in constructing furniture These additional notes are contained in Home Workshop Bulletin No. 5, which will be sent free to any reader who accompanies his request with a stamped, self-addressed envelope



In cutting the points and fillets on a circular saw the ripping fence acts as a stop

TWELVE-ROOM HOME FOR MARTINS BUILT LIKE A FAIRY MANSION

THIS twelve-room bird house for martins has a wide roof which gives protection from rain as well as from the hot sun, and its base is wide enough to allow the young birds to stretch their wings and gain a little confidence before they fly

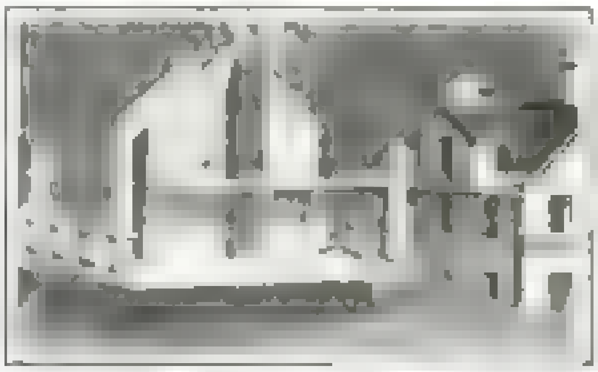
Another of its advantages is the ease with which it may be taken apart and cleaned. The removal of four screws at

The completed bird house is painted white with a green roof and bright red trimmings.

the bottom of the end boards frees the house so that it may be lifted off the base.

While I have tried to make the drawings self-explanatory, a few directions may be of benefit to those who wish to build houses like it. The base, end boards, and rafters are made of ⅞ in. thick wood, all the other parts are ½ in. except the chimney, porch pillars, and trim. The trimming strips are ⅛ in. thick.

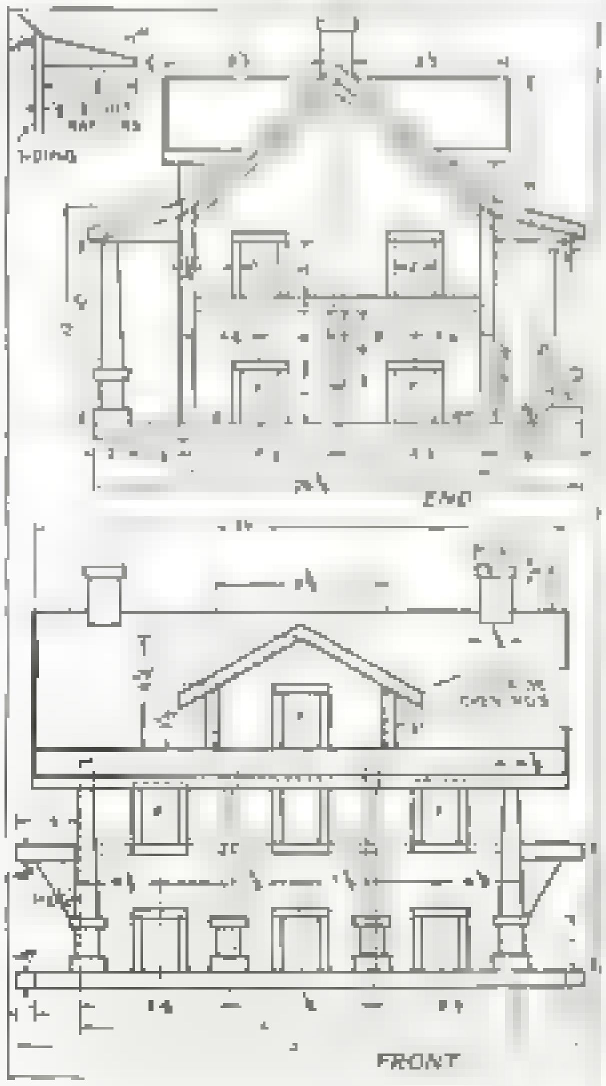
The boards for the base should be cut to a length of 29 in. and nailed together



The removal of four screws allows the outer frame to be lifted to facilitate cleaning

with a 1-in. strip along each end. The two end boards are 16 in. wide, 10 in. high at the peak and 12 in. at the sides. The ½ in. thick side boards are 24 in. long and 12 in. high. The rafters that are supported by the porch pillars carry the weight of the extension roof on each side and therefore should be screwed to the sides before the sides are nailed to the ends. Four rafters are required for each side, one at each end and the others equidistantly spaced between them.

To give the house a symmetrical appearance, I made ten false openings as shown and painted them black. It is hard to tell them from the real openings a short distance away.—F. BAC[illegible]S

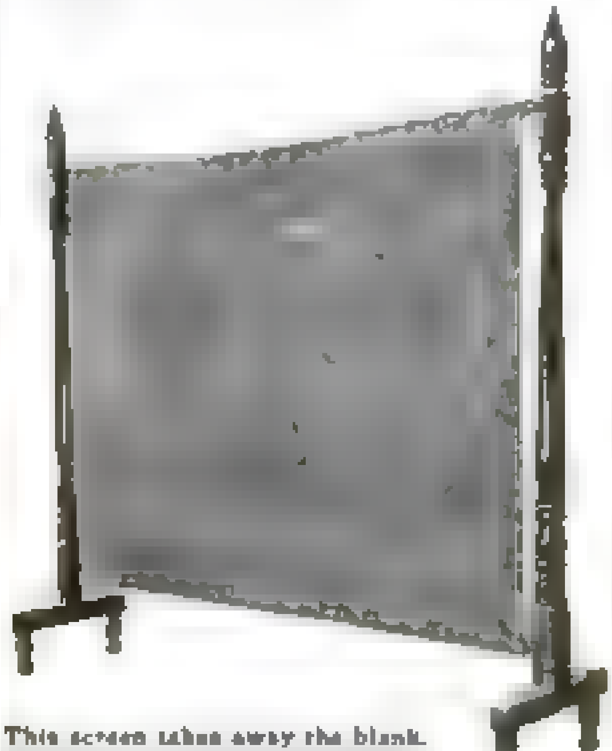


Dimensioned drawings of the house. For the sake of symmetry, there are ten false doors.

TAPESTRY SCREEN HIDES FIREPLACE OPENING

A SIMPLE yet attractive screen for hiding the fireplace opening during the warmer months when the fireplace is not used can be made by the home worker with little expenditure of time and money.

The frame consists of two turned upright pieces (square ones may be substituted if the home worker does not have the use of a lathe), two small crosspieces, four feet, and two pieces of dowel as long as the frame is wide. The covering, which is stretched over the two dowels and held in place with upholstery tacks placed at the back, can be a figured cretonne or a tapestry cloth.



This screen takes away the blank, cheerless look of a cold fireplace.

As to finish—this depends almost wholly on the existing color scheme of the room in which it is to be used. The writer finished the frame with black lacquer.—B. G. S.

Interested in Building a Model Railroad?

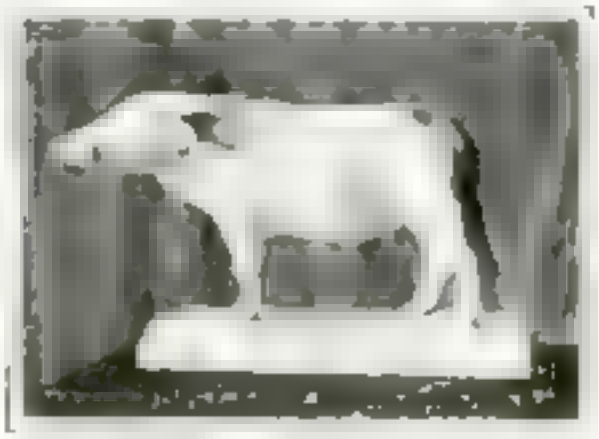
If you are, you undoubtedly wish POPULAR SCIENCE MONTHLY would publish more articles on model engineering. Please send your suggestions for such articles to the Home Workshop Editor. Specify what particular subjects you would enjoy most.

Do you want plans for locomotive models? Then what type and gage? Do you prefer a steam locomotive driven by steam or one that looks like a steam locomotive but is driven by electricity? Or do you wish the outward appearance to be that of a straight electric, oil-electric, or gas-electric type? Would you require completely detailed instructions, or would working drawings and photographs with a brief description suffice? If a sufficient number of readers are in agreement, every effort will be made to publish plans for the models desired.

Paraffin Safeguards Fragile Shipments

AMONG the native trinkets I brought home with me after a year's residence in the Philippines was a small but perfect plaster cast of a carabao. In case of breakage it could not be replaced, since the original mold had been destroyed, and it was otherwise valuable to me, yet because of the ears, horns, tail, and slender legs—the latter integral with a heavy plaster base—the packing of it presented a puzzling problem. The solution proved to be a simple one, which would be equally useful in packing many varieties of small, fragile objects

The cast was coated with thick, warm glue and allowed to get bone-dry. Then it was placed in a wet cardboard box and



An extremely delicate plaster cast of a carabao or water buffalo which was shipped from the Philippines encased in a block of paraffin

melted paraffin was poured over it until the box was full. When this hardened the figurine was in the center of a solid block of paraffin, and the box could be handled without special care

At the end of the journey, an hour in a warm oven melted off the paraffin, and a short bath in warm water removed the surface glue, leaving a perfect casting, already sized and in condition to be dried off and bronzed, painted, or lacquered

But for the coating of glue, the hot paraffin would have been absorbed by the plaster, unfitting it for any finish other than wax; and with any other scheme of protection, the legs almost certainly would have parted from the base

This plan for protecting delicate small articles of value against breakage, as well as against dampness and other damage is applicable to shipments of steel instruments to tropical climates. It also can be used for the preservation of small animal skeletons and the like in the field, and can be modified for crystalline specimens and other objects collected by exploring parties. Once embedded in the paraffin, the specimens can be handled quite roughly without damage.—F. E. Coostas

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WHEN using extension cords in the shop or garage it is often necessary to hang the cord up out of the way Finding that the general practice of supporting the cord on nails or across pipes tends to wear out the insulation, the writer hit upon the following kink: Attach curtain rod rings to the cord about every 4 ft. These can be fastened in place with tire tape. The rings then can be slipped over nails or any convenient projections without injuring the wire.—W. LESLIE TODD.

WEATHER IGNORES THE GROUNDHOG

Continued from page 55)

prophecies to be derived from the goose bone?

A few years ago Norman L. Silvester, of England, made a careful investigation of the belief that certain plants close their blossoms before a shower The most celebrated of these plants is the scarlet pimpernel, which has long been known as the "poor man's weatherglass," on account of its alleged prophetic powers. Specimens of several such plants, including the pimpernel, growing close to a weather station were examined many times a day during three seasons. Comparison with the weather record showed that none of them were at all reliable as forecasters

The blossoms of the pimpernel normally open some hours after sunrise and close some hours before sunset. Silvester found that they failed to open unless the relative humidity of the air fell below about eighty per cent. The process was not affected by other elements or by light. Hence closed blossoms of the pimpernel in the middle of the day indicate comparatively high humidity, but this condition is not necessarily followed by rain. Neither do open blossoms necessarily point to dry weather, for on several occasions the blossoms were found open during a shower!

SOME living creatures are remarkably sensitive to changes in the state of the air around them. Harlow Shapley, Harvard astronomer, found that he could determine the air temperature within one degree by noting the rate at which ants of certain species traveled through a "speed-trap." At one hundred degrees they moved twelve times as fast as at fifty degrees. The rate at which crickets chirp has likewise been found to depend rather definitely upon temperature

The restlessness and excitement of many animals, as well as certain nervous manifestations of human beings, during the onset of a storm are well-known phenomena, though few attempts have yet been made to find out just how they are related to atmospheric changes. It is said that bees are sensitive to the increase in atmospheric humidity that precedes a shower and always return to the hive in time to escape a wetting

The range of time during which natural prognostics hold good is extremely limited No scientific justification has been found for any of the familiar methods of predicting the weather of coming seasons, such as the mildness or severity of a winter, from the observation of animals

One of the few scientific men who have attempted to check the accuracy of some of these long-range forecasting methods was the late Dr. Charles C. Abbott. For a number of years he kept a record of the building of muskrat houses—traditionally a sign of a cold winter to follow—near his home in New Jersey, and also of the relative amounts of food stored each autumn by gray squirrels He could find no relation between these events and subsequent weather

The popular notion that the coloring of the black and brown "woolly bear" caterpillar in the fall shows the character of the succeeding winter, the black parts representing cold spells and the brown parts mild spells, is almost, but not quite, as childish as it seems to be. The coloration is not a forecast of temperature, but it appears from some experiments made by Dr Frank E. Lutz, entomologist of the American Museum of Natural History, that it is not entirely unrelated to weather. Lutz found that caterpillars reared in a moist atmosphere showed more black and less brown coloring than those reared in a dry one.

TONY FOKKER— WIZARD OF FLIGHT

(Continued from page 31)

tried to fly it and it was a total wreck.

When it had been repaired, Fokker continued to teach himself to fly, making longer hops, gentle curves, complete turns. May 16, 1911, at Mainz, he passed the license tests of the Federation Aeronautique Internationale and was granted license Number 88.

With this license in his pocket, he returned to Haarlem, invited to make a flight in connection with a celebration of Queen Wilhelmina's birthday He was welcomed as a returning hero. But when he saw the tiny field, surrounded by ditches and telephone poles, out of which he was expected to fly, his heart sank. He knew he couldn't get his plane out of that boxed-in plot

FINALLY, the committee in charge filled in two ditches and tore down a row of poles. Even then, the monoplane was roaring along, still on the ground, within thirty feet of the first ditch. It got off just in time After that nerve-stretching take-off the flying Dutchman gave the crowds a show they never forgot

He cavorted above the housetops of Haarlem. He circled over the old attic where his models were collecting dust and the kitchen chair with its two levers still stood in a corner He spun around the spire of the Sixteenth Century cathedral and when he landed after a flight of twenty minutes, with his gasoline almost exhausted, he received his first and biggest ovation. The home-town boy had made good!

The committee presented him with an official plaque commemorating his flight. His father gave him a watch that had been an heirloom and promised to aid him with funds in building a better machine

In this and later machines, his escapes from death or injury were many. Once the fabric of the tail, which was laced to the framework, tore loose along the rear spar. With the canvas flapping up and down, threatening momentarily to pull completely loose and send the plane whirling to earth out of control, he slid down to a safe landing

On another flight, a break in the gas line allowed the fuel to pour over a red-hot exhaust pipe. With a flaming motor, Fokker landed. He had just time to leap clear of the plane when the gasoline exploded. The blast knocked him flat on the ground, but he was unharmed. However his worst accident, in which he missed death by a hair was his first

This was in 1912, during an autumn flying week when he was carrying passengers. With a German army officer, Lieutenant Schlichting, he took off and circled the field at 1,000 feet. Below, he could see the wrecks of four machines that had crashed The big crowd was watching, waiting, expectant It looked for the fate of the others to overtake the little plane rocking in the wind a thousand feet above it

But Fokker was confident, sure of himself and his plane. Suddenly there was a crack like a pistol shot. A main wing guy wire had snapped. It dangled below the wabbling wing that threatened to break at any moment

FOKKER'S mind worked like lightning Fighting to forestall death, he made frantic motions for the passenger to crawl out on the wingspar His weight above might counteract the breaking of the wire below The lieutenant clambered heavily out on the wing, balanced himself uncertainly in the stiff wind tottered, recovered himself, plunged his foot through the wing fabric. Fokker saw he could not make him understand what he wanted done. He motioned him back to his seat. *(Continued on page 124)*

TONY FOKKER—WIZARD OF FLIGHT

(Continued from page 123)

Still the spar held miraculously. With the lightest possible touch on the controls, Fokker eased the ship down to 300 feet above the field. Safety was in sight. Then the plane was caught by the bumpy air near the field. The spar buckled, split. There was a cracking of wood, a rending of canvas, and the broken-winged bird went down.

It was several minutes before Fokker came to. They told him Lieutenant Schlichting was "all right." It was only later that Fokker learned he was dead.

For three days, his nerve was shaken. Then he was out again, riding the flimsy ships of 1912-13 with an increasing skill and daring. It was Fokker who first looped the loop in Germany. Soon after Adolphe Pegoud made his first vertical circle near Paris, the Flying Dutchman traced a similar letter O upon the sky above Johannisthal.

With his funds running low, Fokker read an announcement of an open competition by the German army. Although no one realized it at the time, that announcement played a considerable part in shaping the early history of the World War.

The army wanted an easily-transported plane that could be hauled, with spare parts, from airport to airport. No one thought, in those days, of planes flying from one field to another. The machines in the competition were to make a 250-mile tour starting by truck from Johannisthal. At each stop, the ships were to be assembled and flown, then taken down and hauled to the next field by truck. Under various weather conditions, 250 miles of mountain, country and city roads had to be traversed. The winner of the competition would receive an order for ten machines.

Most of the competitors loaded spare parts on cumbersome trailers. Fokker, because of the simple construction of his plane, could load it, with all spares, directly on the truck. The whole operation of assembling or taking down his monoplane required only five minutes.

THE race began. Fokker's unit nosed ahead of the field. Out-distancing the heavier trucks on the hills, speeding away over cross-country roads, twisting easily through winding village streets that tangled up the unwieldy trailers, he often arrived at demonstration points five hours ahead of the rest. Moreover, he won all points on assembly time. From the start, victory was his. When the race ended, this twenty-four-year-old boy had taken his place as the leading airplane constructor of Germany.

He opened a factory near the Baltic Sea at Schwerin, 250 miles from Berlin. Orders for planes poured in. Officers in polished boots and trig tunics jammed his flying school. The youth who less than twenty years before had been climbing trees in the primitive jungles of Java; who less than six years before had been a scapegrace to the burghers of Haarlem, was established as an important manufacturer in a rising industry. His headlong existence seemed nearing quieter days. Then, suddenly out of a clear sky, something happened which made his life take on the pace of a plane in a nose-dive. War was declared.

NEXT MONTH: *the thrilling story of Fokker's experiences during the World War. How he invented the synchronized machine gun and developed a fighting plane that for a time reigned supreme in the hands of Richthofen, Immelmann and the other aces of the Black Eagle. The next installment of this dramatic series will appear in the June issue, on sale May 1*

DEAD WELLS MADE TO SPOUT OIL

(Continued from page 41)

the losses from evaporation and seepage have been known to reach forty percent in three weeks. Even steel tanks lose through evaporation, although tanks painted white have been found to lose one and one half percent less than red tanks, and two and one half percent less than black ones

The new process introduced by Union is but one of many remarkable scientific achievements that are radically changing modern oil production methods. Geologists are harnessing underground streams of water formerly dreaded as deadly enemies to flowing oil wells, and are skimming hidden oil pockets by means of an artificial flood.

THEY are stripping reluctant oil sands of their adhesive petroleum content by blasts of compressed air or natural gas. Looking forward to the time when a scarcity of oil will make petroleum mining pay, they envision deep shafts sunk to the cap rock above oil pools, with a network of galleries from which tubes driven downward will carry superheated steam to scald the oil sands clean

The immense Bradford field, covering an area of 100,000 acres in Pennsylvania and New York, had grown to old age and was declining rapidly in production when it was noticed that an increase in flow resulted from the accidental flooding of a portion of the field by an abandoned oil well

Operators drilled a "five-spot" pattern of wells arranged like the spots on dice, and began to pump water into the center well. Spreading out in all directions, the water drove the remaining oil to surrounding wells. When this was accomplished, an outer ring of wells was drilled, and the center ring became "injection" wells

Wells that had been considered "dry holes" have thus been made to yield thousands of barrels of oil, and many producing wells have multiplied their previous output many times. Thus restored to youth, Bradford field has been given many years to live

Experts predict that it will be twenty to forty years before it reaches its peak production, and that the astounding total of 600,000,000 barrels of oil worth almost $1,000,000,000, will ultimately be recovered

In other fields, engineers have installed huge compressors in which air, under tremendous pressure, squeezes oil from hidden pockets and forces it out through wells at the edge of the field. If the air is allowed to flow out too fast, it forms a channel through coarse-grained sands and escapes without lifting its share of oil, so engineers now meter the air that is forced in, regulating its flow so that it reaches all parts of the field. By this process wells have been rejuvenated and brought to a production greater than when they were originally brought in. Gas turned back into the ground for storage is also frequently utilized as a "repressuring" agent

WHERE underground streams are drowning productive wells, pumps remove the water faster than it can flow in, producing a vacuum that sucks up oil and gas. Some fields thus "unwatered" virtually distill natural gas so rich that gasoline condenses in the vacuum pumps at zero to four pounds pressure

Mining of oil sands has been carried on in Alsace, where all but about eight percent of the original oil is recovered. American sands generally contain so much gas that tunneling would be highly dangerous. Geologists believe that by admitting oil and gas under control into galleries just above the oil zone, and washing the sands with superheated steam, most of the residue can be recovered.

A definite program for getting ahead financially will be found on page four of this issue.

NEW GLIDER RECORDS COME FAST

(Continued from page 59)

Charles A. Lindbergh, Frank M. Hawks, C. S. "Casey" Jones, Amelia Earhart, and others advocate glider training as a safe method of getting into the air.

The main difficulty is that the average glider flight made from a hilltop consists of a hop of only a few seconds. Recently, the Alexander Glider Club, at Colorado Springs, Colo., where members hop off for their flights into thin air at an altitude of 6,000 feet, solved the problem in an ingenious way.

TWO high posts were placed some distance apart, a steel cable connecting their tops. From this cable, a glider was suspended at its center of gravity. Facing a wind, the pilot had to manipulate the controls just as in flight in order to keep the machine headed straight and on a level keel. This allowed him to practice as long as he desired with conditions almost the same as in actual flight.

All over the country, during the past winter, hardy enthusiasts have been demonstrating that gliding and soaring are all-year-round sports. They have flown their silent birdlike craft above snow-covered hillsides in a dozen states.

Probably the most unusual of these winter flights took place in the Lake Tahoe country of California. Here E. B. Laferty, a San Francisco glider pilot, made a series of exciting hops down a white mountain side, launched into the air by a team of huskies.

Ordinarily, a launching crew of half a dozen human runners stretch the rubber cable that shoots the glider slingshot-wise from a hilltop into the air. Laferty asked his friend, "Scotty" Allan, famous dog-team racer of the Yukon, to hitch his sledge dogs to the rubber rope.

The huskies tugged at the elastic cable, stretching it to the limit. The anchor men, holding the tail of the light machine, let go. It whizzed into the air and Laferty guided it like a great hawk down the mountain side. At the end of his ride, he slid to a gentle landing on the surface of a frozen lake.

Another nerve-tingling brand of snow-gliding was exhibited among the Pennsylvania mountains near Buck Hill Falls by Carl Messelt, a professional ski jumper, a few weeks ago. With a short-winged biplane glider strapped to his body, Messelt took off for a combination flight and ski jump.

BUT first prize for unusual motorless machines must go to three Washington, D. C., inventors. Their huge monoplane was made almost entirely of rubberized fabric. Wings, fuselage, and tail were all blown up with compressed air, the pressure within the fabric bracing the machine. When this air was let out, the fifty-foot craft could be rolled and almost carried in a suitcase!

Weird as the idea sounded, the machine actually flew. It received its test at Hoover Field, on the outskirts of Washington, with Joseph Bergling, a local airplane pilot, at the controls. Towed by an automobile, the awkward-looking craft soared aloft and climbed to a height of seventy-five feet.

Instead of ailerons to maintain sidewise balance, the rubber plane had wings that could be warped, or twisted, as in the original Wright machine. At the peak of the climb, a gust threw the ship off balance. Bergling warped the wings, but insufficient movement had been allowed. The low side continued to drop.

Finally, with the wings perpendicular to the ground, the plane side-slipped down in one sheer plunge. It struck on a wing tip and bounced into the air like a rubber ball. The pilot (Continued on page 127)

NEW GLIDER RECORDS COME FAST

(Continued from page 126)

was thrown out and shaken but the plane was practically undamaged. A glider with a wooden framework would have been demolished by a similar drop. It is planned to redesign the craft, increasing the amount the wings can be warped.

A few days ago, a new record for over-water gliding was made in California. Accompanied by a little black and white puppy, Richard Devine piloted his motorless monoplane across twenty-five miles of open sea, pulled by a speedboat. His flight bridged the gap between Los Angeles and Catalina Island.

Another craft which recently made glider history is the *Sierra Madre*, mammoth sixty-four foot monoplane, largest glider in America. Taking off from the top of the Verdugo Mountains, in California, Maurice Collins guided the huge sailplane high over the San Fernando Valley carrying a packet of 600 air mail letters. Swooping down for a landing at the Grand Central Airport Terminals he turned his cargo over to postal authorities, finishing the first soaring air mail flight of history.

Although the world's first glider flight was made in America by John J. Montgomery in 1884 (P. S. M., Oct. '30, p. 161), and Octave Chanute and the Wright brothers carried on their pioneer work here, widespread interest in the sport began in this country only after spectacular flying had been accomplished in Germany. W. Hawley Bowlus and Jack Barstow, in California, lengthened their motorless flights until early last year Barstow unofficially eclipsed the world's duration record by a flight of fifteen hours.

INTEREST in the sport reached its climax in the first national soaring competition held at Elmira, N. Y., last fall. Before the meet the best places among the high ridges of the region were picked by judges who criss-crossed back and forth over the hills in a motored plane noting the strength of the up-currents.

"Trainer" gliders are a recent American contribution to soaring. These sturdy machines are designed to withstand the shocks of awkward landings by beginners and at the same time are light enough to soar. Of the two leading machines of this type, the Franklin costs $675 and the Baker-McMillan "Cadet II" $595.

During the meet one utility machine rode the rising air currents to a height of more than 2,000 feet above its starting point and circled over the surrounding country in noiseless, birdlike flight.

Later, several of the pilots organized an impromptu "Windrider's Orchestra," taking aloft horns and rattles and duck-calls and breaking into clamor each time they soared above the take-off hill and the spectators.

Another unusual stunt at the meet was "refueling the pilot." Maneuvering a light craft directly above the scudding ship in which Walter Backus was seeking an endurance record, O'Meara lowered sandwiches on a 200-foot fishline.

Twenty-four pilots and fourteen machines entered this first competition. During the ten days of flying, 118 hours of soaring was accomplished. Seventy-seven of the ninety-nine flights recorded lasted more than half an hour. And there was not one serious accident during the contest.

Already, glider enthusiasts are preparing for the second Elmira meet next fall. In a hundred places, during summer months, enthusiasts will be hopping down hillsides, trying out new gliders, tuning up old machines, practicing the fine points of handling their motorless ships of the sky.

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

SHOULD LAW SCRAP OLD CARS?

(Continued from page 84)

defects like that. A little while ago they stopped a lot of cars in another state and nearly a quarter of 'em had bum lights that couldn't pass inspection."

"Inspect mine, please," Marceau suggested, and grinned with pleasure when Gus found them in good shape.

"YOU see it's this way, Mr. Marceau," Gus went on as he set about adjusting the car. "Today the roads are jammed with cars. You'll meet hundreds on a trip for every ten you met a few years ago. And everywhere the speed laws have been made more reasonable so all cars travel lots faster now than they used to. I can remember only a few years back when you got pinched on our boulevard if you went over twenty miles an hour. Now if you don't move along at thirty when traffic is heavy you're likely to get a ticket for obstructing the road. Cars are getting more powerful. Weights are not going down. To balance that we've got four-wheel brakes and big tires that get a good grip on the road. The higher speeds of today really are safer than the slower speeds of yesterday, if—and that's a great big if—everything about the car is working as it should.

"There's a lot of talk right now about condemning all cars over a certain age and putting them off the road. We may come to that in the end, but it always seemed to me like a kind of a silly way to look at it. Maybe the people who keep proposing it will get the straight of it after a while. It isn't the age of a car that makes it safe or not. What counts is its condition. A five-year-old car in perfect shape is a lot safer bet than one two months old with the brakes out of whack and a lot of other things the matter with it," Gus concluded as he finished the brakes and started on the next job.

"Aha, my little cabbage!" whispered Marceau, patting the crumpled mudguard of his car affectionately. "Me, I will make very sure they do not condemn you, little one. Beginning with the now we will have your ills fixed at once, or before that, even!"

COUNTERFEITING KNOWN TO ROMAN CROOKS

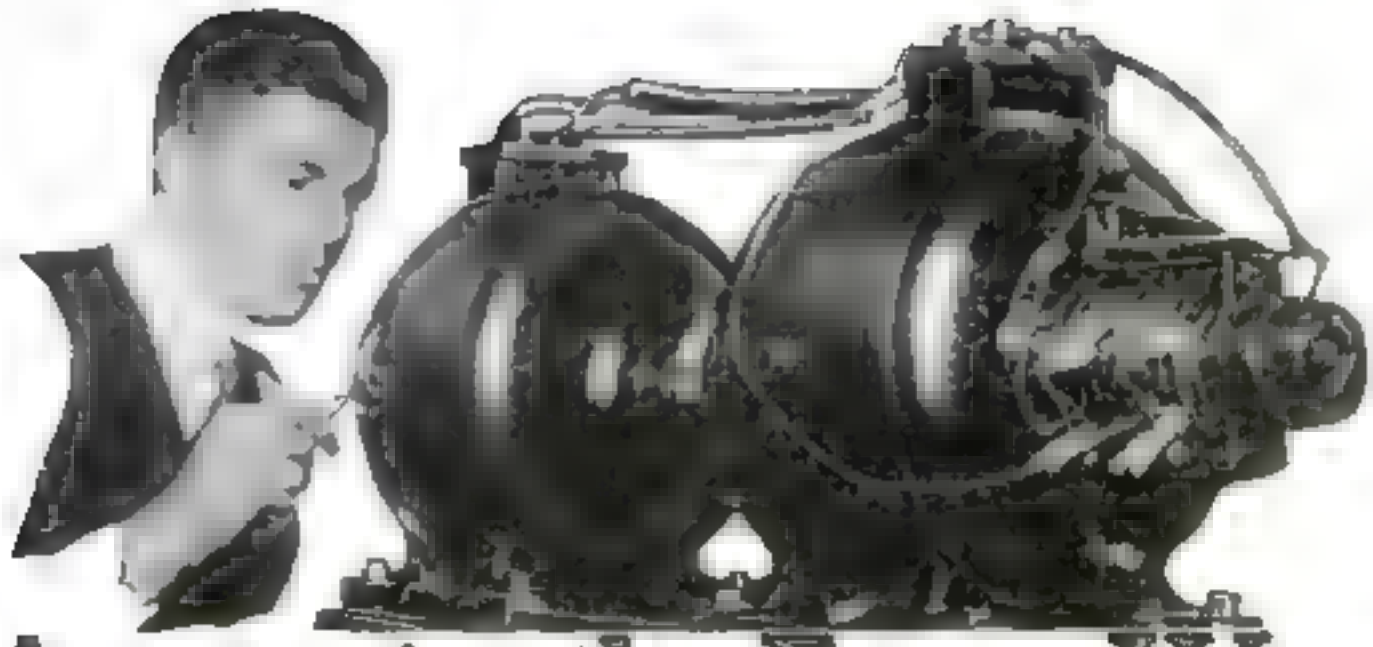
RECENT excavations among Roman ruins in Trier, Germany, add another bit of evidence to prove that counterfeiting is not a crime confined to modern civilization. A number of molds were dug up, several with coins still in them. Analysis of the metal in these showed them to be not of silver, but of bronze, containing a mixture of lead.

The molds were found in an obscure corner of the city, further proving them to be spurious, for legitimate makers of money always worked near the central parts of towns. Roman counterfeiters must have found it more profitable to ply their trade far out in the provinces, for among the several discoveries of counterfeiting establishments dating from the days of the Roman Empire, none have ever been unearthed in Italy.

WALKING STICK LIGHTS AS END HITS GROUND

A British innovation in walking sticks, recently exhibited in London, is an "illuminated cane." Each time the stick is touched to the ground, a small flashlight bulb in its head blinks on and off. Pedestrians who walk along country roads, late at night, thus may warn passing automobilists.

A definite program for getting ahead financially will be found on page four of this issue.



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Don't spend your life waiting for $5 raises in a dull, hopeless job. Now . . . and forever . . . say good-bye to 25 and 35 dollars a week. Let me show you how to qualify for jobs leading to salaries of $50, $60 and up, a week, in Electricity —NOT by correspondence, but by an amazing way to teach, RIGHT HERE IN THE GREAT COYNE SHOPS. You become a practical expert in 90 days! Getting into Electricity is far easier than you imagine!

Learn Without Lessons in 90 DAYS
By Actual Work—in the Great Shops of Coyne

Lack of experience—age, or advanced education bars no one. I don't care if you don't know an armature from an air brake—I don't expect you to! I don't care if you're 16 years old or 48—it makes no difference! Don't let lack of money stop you. Most of the men at Coyne have no more money than you have.

EARN WHILE YOU LEARN

If you should need part-time work while at school to help pay expenses, I'll assist you to it. Then, in 12 brief weeks, in the great roaring shops of Coyne, I train you as you never dreamed you could be trained on a gigantic outlay of electrical apparatus . . . costing hundreds of thousands of dollars . . . real dynamos, engines, power plants, autos, switchboards, transmitting stations . . . everything from doorbells to farm power and lighting . . . full-sized . . . in full operation every day!

Prepare for Jobs Like These

Here are a few of hundreds of positions open to trained men. Our free employment bureau gives you lifetime employment service.

Armature Expert to $100 a Week
Substation Operator
$50 a Week and up
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Inspector Unlimited
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up to $75 a Week
Service Station Owner
up to $200 a Week
Radio Expert up to $100 a Week

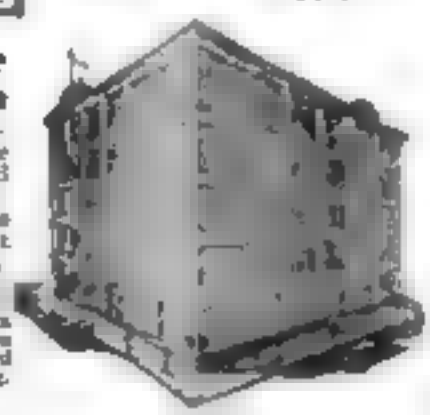
No Books-No Printed Lessons

No books, no baffling charts . . . all real actual work . . . right here in the great Coyne school . . . building real batteries . . . winding real armatures, operating real motors, dynamos and generators, wiring houses, etc., etc. That's a glimpse of how we make you a master practical electrician in 90 days, teaching you far more than the average ordinary electrician ever knows and fitting you to step into jobs leading to big pay immediately after graduation. Here, in this world famous *Parent school*—and nowhere else in the world—can you get this training!

Jobs-Pay-Future

Dont' worry about a job. Coyne training settles the job question for life. Demand for Coyne men often exceeds the supply. Our employment bureau gives you a lifetime service. Two weeks after graduation, Clyde F. Hart got a position as electrician for the Great Western Railroad at over $100 a week. That's not unusual. We can point to Coyne men making up to $800 a month. $60 a week is only the beginning of your opportunity. You can go into radio, battery, or automotive electrical business for yourself and make up to $15,000 a year.

New in Our New Home



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Coyne is your one great chance to get into electricity. Every obstacle is removed. This school is 30 years old. Coyne training is tested—proven beyond all doubt—endorsed by many large electrical concerns. You can find out everything absolutely free. Simply mail the coupon and let me send you the big, free Coyne book of 150 photographs . . . facts . . . jobs, salaries, opportunities. Tells you how many earn expenses while training and how we assist our graduates in the field. This does not obligate you. So act at once. Just mail coupon.

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COYNE ELECTRICAL SCHOOL

H. C. LEWIS, Pres. Established 1899

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SIMPLE HOUSE HAS BEAUTY

Continued from page 77

the two "pine rooms" on the lower floors as perhaps the outstanding interior feature. One of these is the breakfast room, and the other the book room or study. In the former, the walls are finished in unpanneled, vertically-placed molded pine boards having prominent knot formations.

The bay window is similar to those in front of the house, except that it is finished in pine. Pine walls of the book room are paneled, making the construction a little more formal than that in the breakfast room. Ceilings in both are of waterproof wall covering glued to the plaster.

I did considerable experimenting in order to obtain just the right finish for the pine rooms. My intention was to create the effect of antique wood, and I believe I have been fairly successful. The resulting color is a very pleasing tobacco brown. The pine was first sanded smooth and then given a coat of water stain. When this was dry, the surfaces were high-lighted with fine sandpaper.

THIS high lighting, removing color from the raised portions, adds to the aged appearance. After all high-lighting was completed, the woodwork was given a coat of clear shellac. This fixed the stain colors. Then the surface was again lightly sanded to remove little surface granules, and the whole given an application of wax thinned with turpentine and colored with pigment to a dark brown. The wax was rubbed well into all crevices and cracks, where it remained. Then the surfaces were rubbed [illegible] with clear wax.

The book room, just off the living room, has its own outside door. One side is occupied by a built-in bookcase. In the wall opposite is a "secret panel" door that leads into a lavatory. This door, when closed, looks like a part of the wall, and is not noticed by most visitors. In building it, I had one of the panels split on each side and a hinge at top and bottom. The dividing line is scarcely noticeable, largely because of the color and paneled design of the walls.

The main stairway leads to an upstairs hall on which open all of the bedrooms and the bathroom. A feature of this hall is a large linen closet with plenty of shelves and drawers. The bedrooms are papered and the enameled woodwork tinted to match the background of this paper. The bathrooms have a colored tile wainscoting four feet six inches high, and are fully tiled around the tub and shower.

An item of economy is the closed stairway. The absence of a complicated banister simplifies construction. The handrails even are reduced to a minimum, that on the right hand side, as one ascends, being but half of a railing split in two and fastened to the wall. The left hand railing, the one used most in descending, is a full-sized one, supported by brackets. Wall paper comes down to the railings, and the space below them is paneled and painted.

THE basement is so arranged that the business end—that is, the laundry, heater room, fuel room, lavatory, and fruit room—is entirely shut off from the recreation room and a small drafting room which are fully plastered and painted. The walls and ceilings are painted cream and the woodwork a vivid green, which makes the appearance quite cheerful.

Many people have asked why I placed the breakfast room between the kitchen and dining room. My answer is that diners do not like to look into a kitchen—usually the least attractive part of a home—or into the pantry.

You will notice from the plans that a direct line cannot be drawn from the dining room to the kitchen. I believe that every house, no matter how small, should have a pantry. But at the same time, that pantry should not be placed where it will be an eyesore. By a little manipulating of plans, it can be effectively hidden.

The woodwork in the living room, dining room, and entrance hall is painted a light gray, almost white. Walls of the living and dining rooms are covered with a light background, rather brightly-flowered paper. A paper having Colonial figures as the decorative motif covers the stair-hall.

TO contrast with the brilliant walls of the adjoining rooms, the entrance vestibule has painted walls corresponding to its woodwork. The paint is applied over waterproof covering glued to plaster. A tacked-down carpet covers the hallway and stairs, while in the adjacent rooms are rugs, light in tone, on a stained oak floor.

While I am speaking of decorations, I might reveal a bit of good fortune that helped me. For some time I had been keeping in its crate a circular, convex mirror with an elaborate antique gilt frame, that I expected to hang above the living room fireplace of my future home. When the house finally materialized, I began to search for lighting equipment.

Imagine my surprise when I came across wall brackets that looked as if they were copies, on a smaller scale, of my mirror. These brackets, which were stock models and not custom-built, have as their chief decorative feature a small convex circular mirror surmounted by a gold eagle. The harmony between these and the large mirror is perfect.

Lighting equipment in the hallway, dining room, and other parts is in harmony with the general Colonial scheme.

At the end of the house that overlooks the lake, is a spacious, double-decked porch. A door from the living room leads to it.

The garage, shingled like the house, is separate. I did not favor an attached garage, although I build them constantly for my clients. Besides adding somewhat to the fire hazard, the characteristic garage odor usually is noticeable all through the house.

AS I intimated before, the service portion of my home is pretty well isolated from the remainder. Groceries and other merchandise are delivered through the rear door that is but a few feet from the street. The kitchen, by the way, has one feature worth mentioning. The woodwork first was stained a lettuce green, shellacked, sanded, and then finished with varnish to which had been added a quantity of white lead. The result is a translucent finish that reveals the wood grain faintly.

The principal advantage of this method is that the surface can be renewed in spots, as around the sink, without disturbing the base color. It is a simple matter to match the old surface tone by adding the proper amount of white lead to clear varnish.

The house is of conventional frame construction throughout, and is insulated with wood wool in the form of quilted strips. The plaster is applied over a rock-lath base.

Cubical contents of the house are about 19,400 cubic feet. The total cost was, in round figures, $18,000, making the cost per cubic foot about forty-five and one half cents. This cost is figured on rates prevailing just before the present low-price period came, so that the house could be duplicated today for considerably less.

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SOVIET SLAVES REBUILD RUSSIA

(Continued from page 25)

munism, as one of the worst capitalist ways of "bleeding" the workman. The average pay of a skilled man in Russia today is $42 a month, an unskilled man gets only $52. But at Magnetogorsk the average pay comes to $7.50 a day, or $75 a month, and a hustler can make $6 a day, or $180 a month, unheard-of riches for a Russian laborer. Stalin himself and the other Soviet bigwigs in Moscow get only $150 a month. If an American bricklayer were to receive a bigger salary than the President of the United States, wouldn't he feel that he belonged to the aristocracy of the country?

ON THE other hand, the Russian workman feels the sting of the whip when he does not please his masters. "No work, no food" is the law of the land. Nor is this confined to common labor. Not long ago, three engineers fell down on a job. They were sentenced to six months of unemployment. The government decreed that the three men on no condition were to be given jobs within the U. S. S. R. for half a year. In other words—starve to death or leave the country. Giving them a job would be construed as a "counter-revolutionary" act, a criminal crime punishable with exile and forced labor."

This form of punishment probably is the Soviet's strongest weapon in maintaining its power. The Russian, especially the peasant, is intensely home-loving. He clings to the place of his birth and looks upon exile as a fate to be dreaded almost as much as death. For this reason during the reign of the last few Czars, when Russia had no capital punishment, crimes ranging from the theft of a few rubles to murder were punished with exile to Siberia. The communists have reinstated the death penalty, but they use it sparingly, only in cases of high-treason against the Soviet government.

Today, about 1,000,000 Russians are in exile. They are held in remote concentration camps. Probably 200,000 are working in the northern lumber camps. It should be understood that these people are not prisoners in the ordinary sense. They are free to come and go as they please, so long as they don't leave a certain locality. They can have their wives and families living with them. Also, they are paid for their work, but their wages are only about one third of those paid free workmen. To Americans, this naturally appears to be forced labor. But in Russia, where all labor is more or less forced, it is considered as exile, and nothing else.

Among the exiles are men and women who have committed various offenses, but the majority were thus punished for anti-Soviet activities. Let a man so much as be suspected of stirring up anti-communist sentiment, and he disappears. He has been picked up by an agent of the "Ogpu," the dreaded revolutionary secret police. He is given a quick, secret trial and, if found guilty, banished. The list of crimes against the government includes the formation of religious organizations.

THE Soviet is violently opposed to the Church. It calls religion "the opium of the people." In the beginning of the communist regime, all churches were closed. Later, when it was seen that huge masses of the people bitterly resented this, they were, as a matter of policy, allowed to reopen. Now churches of all denominations can hold public services. But the Soviet fears religion so much as a possible anti-communist force, that clergymen are forbidden to form societies that meet privately, outside of church buildings.

With all its might the Soviet is trying to substitute its own fanatical belief in communism for the old-time religion of the people. It would like them to visit the tomb of Lenin, at Moscow, instead of attending church. But the habits of a thousand years are not so easily uprooted. True, hundreds make pilgrimages to Lenin's tomb. But the churches are crowded on Sundays and saints' days.

A recent American visitor to Russia asked a peasant how he liked the change from the Czar's regime to the Soviet. "Well," said the old man, "under the Czar, we didn't have much to eat and to wear, but on Sundays the priest used to tell us that in the hereafter we would sit on golden thrones. Now, we haven't much to eat and to wear, either, and they are trying to take away the golden thrones."

ESSENTIALLY, the Russians are a religious, law-abiding people. This is the main reason for the fact that, though vodka, the Russian whiskey, has been restored, there is comparatively little drunkenness. Under the Soviet laws, marriage and divorce have been made much easier than they were before, but divorce has not increased to any extent. Besides, the government conducts a constant educational campaign against excess and moral laxity of any kind.

Sunday in Russia no longer exists. The church observes it, but the government does not recognize it. The Soviet, for reasons of its own, has changed the calendar, as it has changed almost everything else in Russia. The year begins on October 1 and ends September 30. It is divided into twelve months of thirty days each. The five remaining days are national holidays; in leap years, there are six. Each month has six weeks of five days.

As a good communist is not supposed to believe in Santa Claus, there is, officially, no longer any Christmas, and New Year's and Easter, too, have been thrown into the discard, though the churches observe the religious holidays and any man can celebrate them in church or in private. The national holidays are November 7 and 8, when the anniversary of the 1917 revolution is observed, January 22, the anniversary of Lenin's death, and May 1 and 2, a two-day celebration of what is known as "red labor day."

The five holidays do not count in the calendar, they have only names. Lenin Day," for example, is preceded by January 21 and followed by January 23. The leap year holiday is left open for any celebration the government may proclaim when it occurs every four years.

WORKMEN are on the job four days of the five-day week and rest one. In other words, they have a day off every fifth day. But everybody hasn't the same holiday. At every factory and mine, on every farm and construction job, the men are divided, by the "stagger system," into five shifts, each with a different day off. Thus, all over Russia, one fifth of the population has a holiday each day.

Each of the five days of the week has a color—yellow, pink, red, purple, and green. Cards of one of these colors are given to each of the five groups of men on every job and at every plant. One group has the yellow day off, another the pink, and so on. A man's labor union card, together with his colored holiday card, admits him to the theater, the opera, the movies.

So, if a young fellow wants to make a "date" with a girl *(Continued on page 111)*

SOVIET SLAVES REBUILD RED RUSSIA

(Continued from page 132)

who is employed, he first has to make sure that she is a girl of his own "color." The government actually is urging the people to seek their friends among persons of their own "shade."

The Soviet takes this scheme seriously because it speeds up the nation's work. Under the new plan, the wheels of industry never stop except on the five holidays. Thus, the Russians plug away at their big job 360 days of the year and, in many cases, twenty-four hours a day.

IS IT any wonder, then, that the Soviet is making sufficient progress to worry the rest of the world? Take, for instance, the giant tractor plant at Chelabinsk, in the Urals. Under the direction of John K. Calder, of Detroit, and three other American engineers, 12,000 men started work there last July. Now, nearly 100,000 cubic yards of earth have been excavated, and the foundations laid for the world's biggest tractor factory, which is to turn out 50,000 ten-ton, sixty horsepower caterpillar tractors a year.

Or take the asbestos works at Azbest, in the Siberian Urals. Two years ago, this remote little place, 1,100 miles from Moscow, had a population of 10,000. Today 500,000 men are developing a thirty-six-mile asbestos deposit, containing 12,000,000 tons of high-grade asbestos. In 1913, the output was 13,000 tons a year. In 1927, it was 26,000. Then, in 1928, Walter A. Rukeyser, a New York engineer, took charge of the job. Last year, he produced 56,000 tons—more than double the 1927 output, and more than four times that of 1913!

What will the Soviet do when men of the type of Col. Hugh L. Cooper, who is building the huge Dnieper Dam, Calder and Rukeyser leave Russia?

The government is pushing technical education to the utmost. In 1913, under the Czar, there were 2,877 technical schools and colleges in Russia with a total of 267,000 students. Today there are 4,803 technical schools, with 612,000 students.

When, in 1933, the contracts with the American engineers run out, there will be a crop of Russian engineers to take their places. But they will be men of an entirely different stamp. First of all, they will lack the necessary experience. But, worse still, the Russian engineer hates responsibility.

THE Soviet well knows this and is worried about it. Not long ago, it called for 3,000 more American engineers and 10,000 American skilled workmen. The latter, by the way, are paid from $200 to $300 a month, deposited for them in American banks, and besides they get from 300 to 400 rubles ($150 to $200) to spend in Russia.

If a sufficient number of Americans answer the Soviet call, work will proceed as before in 1933, provided the communists can keep their people under control. One way in which they are trying to do this is the Youth Movement.

Today, the Youth Movement has about 6,000,000 members. They include the "Young Octobrists," children from eight to eleven, the "Pioneers," from ten to sixteen, and the "Komsomals," who are from fourteen to twenty-three years old. Every day of their lives, these young people are grounded in the communist doctrines. Almost from nursery age on, they are taught that it is up to them to establish the red dictatorship that shall rule the world.

Is it any wonder that statesmen everywhere outside of Russia are watching this experiment with some apprehension, and are wondering seriously about the outcome?

SEEK DRUG TO SAVE DOPE FIENDS

(Continued from page 22)

drug fails to replace cocaine. Local anesthetics can be produced by applying cocaine to the skin or tissue. But novocaine must be injected. Last year statistics show physicians used more cocaine than usual, indicating a need for other and more satisfactory substitutes. Codeine is another product of the chemists laboratory which has had much of the habit-forming property of narcotic removed.

IT IS entirely possible theoretically, scientists declare, to "keep the bee and remove the sting"—to produce a wide variety of narcotics with the dangerous elements removed. This is the problem of the Virginia chemists. They are attacking it from two angles. By purifying opium through different stages, they hope that somewhere along the line the dangerous ingredients will be left behind. The second approach is through a study of the chemistry of molecules.

This is believed to hold the real clue to the mystery of the habit-forming properties of narcotics. Any substance that gives a feeling of well-being to the user is habit-forming. There are, for instance, tea and sugar addicts. But this is something apart from the terrible grip with which drugs hold their victims. The really dangerous substances, such as narcotics, produce a false sense of well-being while at the same time they are destroying the body and mind of their victims.

A single injection of morphine, given at a hospital, has resulted in addiction which could not be broken by the victim. Usually those most subject to the hold of drugs are the nervous type, high-strung and emotionally unstable. It is hoped that the chemists in the University of Virginia will uncover the secret of the strange changes narcotics cause in the human system.

A few days ago, at Cornell University, Ithaca, N. Y., Dr. G. H. Richter announced a discovery that may throw light upon this problem and suggests the physical cause of addiction. He found that narcotics and other habit-forming chemicals, such as alcohol, cause a thickening and whitening of the nerve cells. Unconsciousness results when this thickening or coagulation in the cells reaches a certain point, and it returns when the cells resume their normal, water-clear appearance.

When drugs have been used for some time, he reports, the cells do not revert completely to normal and the coagulation in them produces an irritation in the nerves which he believes creates a craving for more of the drug.

With a research companion, Dr W. D. Bancroft, Richter is attempting to find a harmless chemical that will eliminate such coagulation and bring the nerves back to normal without harming the body. Such a discovery, he suggests, would prove of great aid in the treatment of addicts.

MUCH is still unknown about the precise effect of narcotics upon the various organs of the body. Their mysterious action in upsetting the fat metabolism, or chemical changes in the living cells of the body, and the water distribution of the human system is only partly understood. Most addicts are of the thin, scrawny type. Yet, when the drug is being withdrawn, during cures, they may lose as much as fourteen pounds of water in twenty-four hours.

Not long ago, five Louisville, Ky., research workers carried on tests with animals that had been given morphine over a period of time. When the drug was stopped, a sudden redistribution of water was found to take place in their bodies. The blood, spleen, and surface tissues all showed a loss, while the previously water-shy organs—the brain, kidneys, and liver—became gorged with water.

Upsetting the water distribution of the body is only one of the many little-understood effects of narcotics.

In 1929, Congress authorized the establishment of two large farms for treating addicts. The first, near Lexington, Ky., will be put into operation early next year, accommodating nearly 1,000 patients, those who apply voluntarily and those who have been convicted of crimes against the Federal Government. The second farm, farther west, will be established soon afterwards. Besides giving valuable statistics for studying the effects of drugs, these farms will provide opportunity to discover the best methods of treatment and the facts about the causes of addiction.

THE menace of dope has been understood only in recent years. Practically all antinarcotic legislation has been passed since 1897, thirty-four years ago.

In the laboratory at the University of Michigan, where the synthetic products of the Virginia chemists will be tested, rabbits, guinea pigs, and cats will be used.

The poison effects and the dosages required to produce unconsciousness will be determined first. Such tests have revealed a curious fact. A rabbit that weighs only a fraction as much as a man can stand a dose of morphine that would kill a human. A dog also can take more dope than the average man.

The laboratory workers in Michigan will proceed slowly. The new drugs will be tested from every angle before they are released for human use. For, in the past, many narcotic innovations have proved in the end a curse and not a blessing.

About the time of the Civil War, the hypodermic needle was first introduced for injecting narcotics into the human system. At the time, it was said that by this method morphine could be administered without danger of causing addiction. The dreadful fallacy of this assertion did not become apparent until too late, and probably nothing did more to spread morphine addiction than the hypodermic needle.

Again, in 1884, the local anesthetic properties of cocaine were discovered. Immediately the drug was applied to catarrh snuffs and nasal sprays. An army of cocaine addicts resulted, increasing still further the use of dope.

THEN, in 1898, heroin, a refined product of morphine, was put on the market. It was advertised as an opiate that would not cause addiction. Again the terrible mistake was discovered—too late. It was nearly ten years before the medical profession fully awoke to the menace of heroin, and a legion of innocent victims were added to the slaves of dope during that dreadful decade.

Recalling such previous disasters when new narcotics and treatments were announced prematurely as "safe," the present experimenters will make haste slowly, testing every step as they go.

Seventy-five years ago, there were no drugs to relieve headaches and similar pains except dangerous, habit-forming opiates. Now, there are a wide range of relatively harmless drugs, such as coal-tar derivatives. And the production of novocaine has pointed the way to a new branch of chemical research that may relieve the world of the blighting curse of pernicious narcotics.

RADIO'S MYSTERY WAVES EXPLAINED

(Continued from page 134)

is obvious that you will not be interested in short wave reception if all you want is radio entertainment in the form of good musical features and other program material. The short waves, however, offer hours of experimental entertainment to the man who likes to play with radio apparatus.

On these pages are illustrated in picture diagram form the four most useful types of special short wave receiving circuits.

FIGURE 1 shows the simple one-tube circuit. Figure 2 shows the same circuit with a coupling tube added, the latter being of the screen grid type. Figure 3 shows the two-tube circuit revised so that the coupling tube gives radio-frequency amplification. Figure 4 shows a detector-oscillator hook-up to be connected to the antenna and ground binding posts of a broadcast receiver to make a short wave superheterodyne.

In these diagrams similar parts are marked with the same letters. For example, *D* in each case is a variable condenser having a maximum capacity of .0001 mfd. Assuming that the coils are wound on three-inch forms, the grid coil *B* in each diagram should have three turns of wire for fifteen to thirty-three meters of wavelength frequencies, eight turns for thirty to sixty meters, sixteen turns for sixty to one hundred meters and thirty-two turns for 125 to 250 meters. If the coils are wound on forms one and five eighths inches in diameter, they should have six and one half, thirteen, thirty-four, and sixty-seven turns respectively.

In each case coil *A* is the antenna coil. Its dimensions are not critical. Anywhere from two to five turns of wire will do very nicely. Coil *C* is the tickler coil. Its function is to cause feedback and therefore regeneration. In theory a tickler coil should have just enough turns to cause even feedback through the wave range for which the coil *B*, with which it is used, is designed. In three-inch size coil *C* should have two, four, six, and fifteen turns to match the four *B* coil sizes given. If coil *B* is one and five eighths inches, coil *C* should be four, seven, twelve and twenty turns respectively.

In winding *B* it is well to use larger wire, say No. 14, for the coils with few turns and fine wire for the coils with many turns. Any *A* or *C* coil can be wound with fine wire a quarter of an inch from, and on the same form as, coil *B*.

YOU may find that coils you wind do not cover exactly the range of frequencies you want. That is quite likely due to slight differences in winding. In that case adjust the coil to the range you want by increasing or decreasing the number of turns.

In each diagram *E* represents a fixed condenser having a capacity of .0001 mfd., and *G* represents a grid leak of two megohms. You may find it necessary to use a smaller or larger value at *G*. *H* in each case represents a variable resistance having a maximum value of 50,000 to 50,000 ohms. *R* is a radio-frequency choke coil in each case. *M* is a rheostat and its resistance is determined by the tube and battery you use.

No shielding is necessary in these short wave circuits except that in Fig. 3 where it is indicated by dotted lines. Two box type shields should be used large enough to include all of the apparatus shown inside the dotted line for each shield.

In assembling the detector oscillator circuit of Fig. 4 the two coil units should be placed as far apart as possible. Note that this unit is of the A. C. type, because in most cases it will be built for use with a modern full electric type receiver.

BALSA, MIRACLE WOOD, FINDS AMAZING USES

(Continued from page 57)

finish off uneven corners or irregularities outside the cabins. These make a smooth surface that does not offer so much resistance to the roaring blast of the slip-stream or the screaming winds of the high altitudes.

Engineers who built the big British dirigible *R-100* used balsa wood on a large scale. Balustrades, panelling, furniture, decks, and bulkheads were built of this material. Her ill-fated sister ship, the *R-101*, was finished in the same manner.

As the field of use for balsa widened, its price became lower, making it available for many more jobs. Naval architects specified it for furnishing the interiors of light high speed yachts. Building engineers used it, as the silk people did, to quiet heavy machinery.

TALKING motion picture producers found this material valuable for sound proof booths used in their productions. Radio engineers used it in broadcasting studios in the same manner.

Furniture builders and radio people used it for packing their products for shipment. Having a smooth silky surface it does not mar or scratch the smoothest finish in cabinet and furniture making. Being almost as soft as rubber it protects delicate mechanisms from shocks and jars while carried around in packing crates. So balsa blocks are placed inside packing crates to act as cushions between the sides of the crate and the contents.

When you go to a beach or seashore resort you may see many other uses of balsa wood. Those small floats that support the life lines where they extend out through the waves often are made of it. That life preserver you see hanging in front of the life guard's station may be made of balsa. The surf board on which those people are playing over the sleek-backed breakers may be made of this wood. It is so light that carrying the board up and down the beach is easy. The ball which those children are tossing about may also be made of balsa wood.

You may think it a far cry from tropical jungles and the trenches to beach playthings, but the next use of this wood that you will see is still more amazing. Go to one of the refreshment stands, see the truck delivering ice cream—by the aid of balsa wood. Large quantities of this delicacy are transported about the country in trucks fitted with balsa wood bodies.

HERE the strange tropical wood serves a double purpose—it is both a structural material and an insulator. Its hollow formation gives it the effect of a double wall keeping out the heat. At the same time it has sufficient strength to be used in truck bodies without any framework.

The demand for balsa has grown so great that it is no longer obtained by barter from the Indians. A firm of American importers now has plantations in Ecuador where they raise their own trees. Balsa logs are sent by shiploads to a plant in Brooklyn, N. Y.

As it comes to this country, its practically hollow interior is filled with countless tiny tropical organisms that would eventually destroy it if allowed to remain in the wood. These are baked out by a heat treatment process in a dry kiln before the balsa can be used.

Now we come to what is perhaps the most astonishing use to which this material is put. Chips and sawdust which result when the wood is cut up are carefully swept up and baled. They are then sent to a large powder factory which uses them in making dynamite for blasting purposes, the kind used in highway construction and foundation excavations.

MAP EARTHQUAKES TO SAVE ROADS

(Continued from page 40)

which movements of the earth are most frequent, notably the San Andreas fault of central and southern California, running parallel to the coast. At right angles to such known faults, the engineers sent survey parties into the interior to build up a network of exactly-measured lines.

Points along the lines were then pegged with 400 bronze disks set into concrete pedestals to form permanent "bench marks" or reference points at intervals of two to five miles, like huge thumb tacks on a drafting board. They "hold down" the Government's earthquake map. This is the work that has just been completed in California.

SOMETIME between 1934 and 1936 the engineers will return. Once more they will go over the same survey lines with their instruments to find if any of the bronze markers have moved, up, down, or sideways, and if so, by how much. This information will tell builders of bridges, dams, railroads, and highways what sections of the country are most likely to shift.

Since a movement of only a foot or two of any mark would be significant, the survey had to be run with extraordinary precision. When they made their measurements for base lines, the engineers used special Invar steel tapes which change in length only a minute amount in various temperatures and even this change had been carefully gaged by the U. S. Bureau of Standards.

Three independent surveys started from Point Reyes, Monterey, and Newport toward the interior. Across valleys, the sun flashed from the mirrors of the engineers' heliographs as they ran their survey lines. Flashlights were used at night—a comparatively recent method—for signaling between peaks fifty or a hundred miles apart.

Important scientific knowledge may be gained from the survey, as well as practical information, concerning the location of zones of earthquake activity. The work even may lead in the future to predicting earthquakes in advance. Earth movements are now known to be a skin phenomenon of the earth's crust, not deep-seated.

Several years ago, two shocks swayed buildings at Wallace, Idaho. They were felt 1,000 feet underground in a near-by mine, but not at the 2,000-foot level. The greatest recorded depth at which an earthquake started was sixty miles, but anything approaching this depth is rarely observed.

Surface movements of the earth, however, are probably far more frequent than many imagine. Today about 8,000 earthquakes are recorded yearly on the smoked-paper charts of seismographs. But it is estimated that if the number of seismographs were greatly increased, the earthquakes detected would jump to almost 40,000 a year.

TALKING LIGHTHOUSE NOW GUIDES SHIPS

A LIGHTHOUSE that talks has been installed at Cumbrae, on the Scottish coast, to tell mariners their whereabouts in foggy weather. The radio-equipped beacon is furnished with phonograph records that play its name into a radio transmitter and broadcast it over the mist-shrouded waters. At the same time the foghorn is sounded.

Since the horn's sound takes time to pass through the fog, while the radio broadcast is received almost instantly by the ship's wireless set, the difference between the arrival of the signals gives seamen an idea of their distance from the beacon. The talking signal and foghorn are synchronized, so they leave the lighthouse at the same instant.

COSTLY NUISANCES YIELD RICHES

Continued from page 43

than a gallon of fairly high grade gasoline?

Equally as dramatic as the story of oil and gasoline is that of platinum. Although it was never a nuisance, this material, which today is far more precious than silver or gold, has shot through an amazing range of values.

The American Numismatic Society, in New York, has in its collection counterfeit coins made of genuine platinum. In the days when it was cheap, "suckers" were sometimes victimized by being sold "gold bricks" that were only gold plated, the insides being blocks of platinum.

A Russian jeweler who made a crown for the czar of platinum instead of silver is said to have been put to death for the fraud.

AT Columbia University, chemistry students are shown a china tea set, plated with platinum. It was made in Russia, too. A czar had ordered a silver plated set, and for the purpose had given the maker several bars of silver bullion. But the man locked the silver away for himself, and substituted platinum, *which he obtained from an old stovepipe!*

W. D. Turner, professor of chemical engineering at Columbia, explains that before its unusual properties were discovered, many humble articles were made of platinum.

"I can't think of any other material," he declares, "which would make a more satisfactory stovepipe."

The day of the perfect stovepipe was brought to an end by the demands of luxury and industry. Great quantities of platinum began to go into jewelry after it became valuable because of certain important chemical and physical characteristics.

When heated it has almost the same rate of expansion as glass, so it can be used where metal is to be fitted to glass, as in the lead-in wires of electric light bulbs of a few years ago. It resists corrosion by many substances which attack other metals, and so is suitable as a container for corrosives.

This was not all.

Chemists working on a process to make sulphuric acid from sulphur dioxide, the gas that troubled the copper refiners, knew that the first step was to add oxygen from the air. But the sulphur dioxide and the oxygen refused to unite.

The two substances were brought together in contact with a platinum screen, *and the desired combination took place immediately.* The compound, sulphur trioxide, "fell like snow." It readily dissolved in water and formed the sulphuric acid that was wanted.

AT THE Government ammunition and fertilizer plant at Muscle Shoals, there were nearly 700 platinum screens to force ammonia gas to take oxygen out of the air. The resulting gas, when dissolved in water, formed nitric acid, to be used in making explosives.

In these processes, the platinum itself was not altered. A material used in this way to bring about chemical action of other substances, is known as a "catalyst." The discovery that platinum is effective in many such cases was a large factor in its skyrocketing price.

It is only one of many materials to which new values have been given by the discovery of new uses. Mankind, living in a world full of treasures, is just awakening to them, consciously seeking them.

"We no longer depend on chance to discover these treasures," says Professor Turner. "We are emerging from the age of accidental discovery. This is an era of research.

"Industrial corporations see the possibilities. They are maintaining larger and larger staffs of scientists to work out their problems and take advantage of the opportunities which are everywhere.

"In America's universities alone there are probably ten thousand persons engaged in research. If we consider industry, the hospitals, and all the Governmental and private institutions, we will find perhaps a half million persons directly or indirectly engaged in research organizations.

The accomplishments of these people are causing dramatic changes.

Sawmills, not long ago, were constantly put to trouble and expense in disposing of their scrap. Great heaps accumulated. If left too long they would rot. If set on fire their sparks created a great hazard. The scrap had to be destroyed in special burners, with extra protection against sparks.

NOW the scrap instead of being an expense is a big asset. It goes into the making of some rayon. It can be profitably reduced to charcoal. It can be distilled to make wood alcohol, various acids, and lacquer solvents.

Oat hulls and corncobs also help to make synthetic lacquer, capable of giving a beautiful, smooth, hard finish to automobiles and furniture. The oat hulls in former days might have clogged the drainage systems around cereal mills. The corncobs, after lying in enormous, unsightly stacks around the corn elevators, might have been burned.

Many mills preparing wood for the manufacture of paper and rayon convert it by chemicals into what is known as "sulphite pulp." Waste liquors from this material often caused complaints that streams were being polluted, and many mills were ordered to end the nuisance.

Out of the offending liquors it is now possible to extract a substance known as "carvacrol." It can be used as the basis of brilliant dyes, of a wide color range.

The government of France, many years ago, seeing the need of baking powder for cheap light bread, subsidized its manufacture. Hydrochloric acid was a by-product of so little value that it was thrown away in large quantities.

It poisoned streams, killed fish, and undermined houses. Its fumes in the air destroyed vegetation.

Unable to dispose of it satisfactorily in any other way, the factories absorbed it in lime. By this method they produced bleaching powder. It was useful not only for bleaching, but as an antiseptic and a purifier of water.

TODAY all factories of that type are out of existence, and an electrical process, using salt as the raw material, makes soda. The companion product is still chlorine, which as an element in the hydrochloric acid once played havoc with the surroundings.

Chlorine was one of the deadly gases used during the war. In various combinations it also proved one of the most effective of the antiseptics. It sterilizes water supplies for entire cities. Each year hundreds of thousands of tons of this gas are used in the United States alone.

The creamery industry is the field of another chemical triumph. The old nursery lines can be truthfully paraphrased:

"Where are you going, my pretty maid?"

"I'm going to milk the cow," she said. "I'm going to milk her not only of milk, but of unbreakable cups and saucers to serve it in, and eyeglass rims, beads, fountain pens, massage cream, glue, and waterproofing for paints."

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COSTLY NUISANCES YIELD RICHES

(Continued from page 138)

Milk contains material for all those articles, and more. Not long ago, millions of pounds of it each year were being wasted. Many large creameries, busy selling butter fat for butter and ice cream, dumped out the skim milk.

Chemists analyzing the skim milk found that it contained a substance known as "casein." This has become the basis of a new, important industry.

A remarkable glue can be prepared from it. When it is used in fastening woodwork, the joints are stronger than the wood itself. The Germans made wide use of it in airplane construction. Testing its resistance to moisture, they found that a glued joint could be boiled in water and would still hold.

COTTONSEED, within the space of half a century, has been transformed from a waste and a nuisance to the source of scores of useful products.

The fuzz that clings to the outside of the seed is taken off as "linters" to go into the production of explosives, celluloid, writing paper, artificial silk, carpets, rope, twine.

During the war, fortunes were made in dealing in these linters, which were sought in great quantities by the ammunition factories.

After the linters are removed the hulls are cut off and used for more explosives. Also they are valuable as stuffing, fertilizer, and feed. One recent demand has been for "greens" on midget golf courses.

The kernel, taken out of the hull, is ground into cake and meal, which makes confectionery and flour for bread, cake, and crackers. It also makes dyestuffs, and more fertilizer and more stock feed.

The cottonseed, besides feeding livestock, relieves them of at least a part of the burden of supplying humanity with food by their bodies. For in preparing the kernels, the mills crush out an oil which is converted into high grade cooking fats to be compounded with or to take the place of lard and other animal greases.

THE oil also produces oleomargarine, butterine, salad oil, medicine, cosmetics, and oils for illumination and lubrication. It is used for tempering tools, for mixing with paints, and for making soap, washing powder, roofing tar, and dyestuffs.

Other chemists with an interest in coal have succeeded in capturing from its smoke the gas known as carbon dioxide. Hundreds of thousands of tons of it are used annually to make ordinary soda water. Not all of it comes from coal. It can be obtained also as a by-product, often wasted, in the fermentation of sugar into alcohol.

Not long ago coke, the form of coal needed by many industries, was made in ovens that belched out all the smoke and waste gases. Nearby communities were smirched with soot which filled the air.

This waste probably amounted to $75,000,000 a year! Today probably two thirds of the coke is made in ovens that keep the smoke out of the air—and use it.

One of the chief substances recovered in these "by-product ovens" is ammonia, and this alone is said to pay the cost of operation. The once troublesome fumes also yield gas for city mains, and coal tar.

Today the tar itself is redistilled for a variety of light oils. These form the basis of aniline dyes of unlimited color variety. They are also used in the manufacture of high explosives, such as TNT. They make medicines and antiseptics which during the war were used in treating wounds inflicted by explosives made from the same source. They also make synthetic perfumes and synthetic flavors.

PILL BOX CAMERA TAKES BIG PHOTOS

(*Continued from page 27*)

shutter open. Instead of using household current, the bulb can be fired from an ordinary flashlight battery, if desired, and special holders for this purpose are obtainable from photographic supply houses. Once used, the bulb is thrown away. Because of their lack of fire hazard, they may be used where flashlight photographs, until now, have been forbidden.

Camera men have descended into the New York subways and taken pictures of rush-hour crowds, battling to get into car doors. Powder flashes would have filled the place with noise and smoke.

PICTURES of leopards and snakes at the Bronx zoo, in New York, were recently made with electric flashlights. Thoroughbred horses at a horse show in the same city posed for similar pictures. In both places the nervousness of the animals had hitherto caused flashlights to be banned.

The annual opening of the Metropolitan Opera House, in New York, long a forbidden portal to flashlight men, was another recent conquest of the electric bulb. In industrial plants the bulbs are now used to photograph great machines. As many as seven are fired at once, in a special hand reflector, giving, for a fiftieth of a second, a light of more than a million candlepower!

A recent invention is a special gun that fires the flashlight bulb and trips a camera shutter simultaneously, which newspaper men used to good effect in taking night pictures of riot scenes during a New York strike not long ago.

Most startling of innovations in "still" photography, however, is Dr. Hutchison's remarkable process of enlargement, opening as it does the way to cameras of almost microscopic size. It is perfectly possible, Dr. Hutchison told this writer, to build a camera so small that it may be disguised as a cuff link, or a stud for a dress shirt. Its lens would be no larger than a grain of buckshot. A wartime spy, equipped with such an instrument, could snap away unobserved and return with perfect photographs of enemy fortifications. They could be enlarged to reveal every detail.

Dr. Hutchison took me into his laboratory and showed me a photograph of his daughter, that he had enlarged to a size of about two feet square. Then he showed me the original, a tiny piece of a negative, not more than half an inch long and wide! Yet the enlargement might have been a print from a full-sized negative, so free was it from any trace of "grain."

THIS "grain" is something that anyone may see if he takes a piece of film such as the negatives the finisher returns with his prints and looks at it under the microscope. The image on the film is then seen to be made of black specks—tiny grains of metallic silver. If it were enlarged to great size, without special treatment, it would resemble a bad newspaper illustration in which the dots of the half-tone are obtrusively evident.

By treating the film with a combination of liquids that is his secret, Dr. Hutchison told me, before the developing process is complete and the film has hardened, he changes the grains so that they present a dotless surface for enlargement. A snapshot of two and one-fourth by three and one-fourth inch size, he estimates, could thus be enlarged to a sharp picture nine by seventeen feet and that would cover a wall of an average room.

There are other fascinating recent developments in "still" photography—in cameras, lenses, photo fin- (*Continued on page 142*)

PILL BOX CAMERA TAKES BIG PHOTOS

Continued from page 141

ishing, and spectu processes. Here are the high spots of a few of them

Recently arrived in this country are cameras that use standard roll film but take twice as many pictures of half the size upon it as the instruments for which it is designed. One such camera uses "vest pocket size" film. Two special windows make it easy to turn the film to the right spot for the successive exposures, watching the number appear first in one window and then in the other.

Not new is the "Big Bertha" camera which was introduced three or four years ago, but it has at last found an established niche for itself in news and sport photography. Three feet long, it enables a photographer to sit in a grandstand at a baseball or football game and photograph the players as if he were standing beside them.

Lenses, the "eyes" of cameras, have come in for surprising innovations. An extraordinary new lens developed by an American manufacturer for cameras of the larger sizes has the unique property of combining high speed with improved "depth of focus," or the ability to photograph both near and far objects sharply at the same time.

Hitherto any high-speed lens, that is, a lens suited to making short exposures in poor light, has possessed but little depth of focus. But the new "Beach multi-focal lens," as it is known to photographers, is of peculiar construction. Rings are ground concentrically on its glass faces, each ring focusing objects at a slightly different distance. Though it seems contrary to natural laws of optics, the combination of rings has been found to focus near and far objects sharply in the same picture without sacrificing the high speed of the lens.

PROBABLY the fastest camera lens in the world is very near it is one invented a short time ago by Dr. W. B. Kayton, for astronomical photographs. With it astronomers at Mt. Wilson Observatory in California have recorded nebulae traveling at 8,000 miles a second through their 100-inch telescope. Hitherto speeds only up to 2,400 miles a second have been clocked. And one night's exposure of a plate is sufficient with the new lens, to photograph extremely faint stars, instead of four to five as before. To a photographer the fact that the lens measures two inches in diameter and is mounted hardly more than an inch from the tiny plate that it uses accounts for its extraordinary light-gathering power.

Amateurs who develop their own films and plates will be interested in two other innovations. It has long been known that exposed films can be treated with certain dyes that "desensitize" them so that they can be developed in moderately strong light instead of the usual ruby lamp of the darkroom. Recently an improved green dye has been placed upon the market for this purpose. After a brief immersion in this bath films can be developed and the photographic enthusiast can watch his pictures "come out" in bright yellow light.

Giving prints a glasslike finish is commonly done by drying them on japanned sheet of metal known as a "ferrotype plate" and then peeling them off. Now a new type of plate has appeared, covered with chromium plate, that is much easier to handle because it doesn't become scratched.

While experts still are seeking a simpler process by which the amateur can make good "still" photographs in natural colors, two New York musicians whose hobby is photography worked out a scheme for color photography of such promise that a large photographic firm *(Continued on page 144)*

PILL BOX CAMERA TAKES BIG PHOTOS

(Continued from page 142)

bought their invention and is continuing their experiments.

Meanwhile the "movies" have benefitted by advances. Already devotees of the "talkies" may have noticed one remarkable advance in recent months. When the characters stop talking, there is silence, complete and absolute. The proverbial pin might drop in the theater, and be clearly heard.

"Silent talkies," as engineers term this modern development, represent the fruition of years of labor. Through a new process developed by the Western Electric Company, most of the new films are being made in this way. The method is a complicated one of electric sound-recording circuits, but the result is simple.

FORMERLY the border of the film, used to record sounds, was left blank when silence reigned on the stage. Transparent, but not quite uniform in density, its lack of uniformity caused little ripples of sound. Now it is "blacked out" and is perfectly opaque until someone begins to speak.

Have advances in the silent movies kept pace with "still" photography and the "talkies"? Last winter, Baron Shiba, the Japanese engineer whose name long has been associated with high-speed photography, answered that question. Until then, he had been satisfied to snap some 20,000 pictures a second of flying bullets and whirling airplane propellers, in his laboratory, projecting them so slowly that anyone could follow the "slow motion" movements of his mechanical actors. Now he announces that he has doubled the speed of his camera to take 40,500 pictures a second. Film fairly flies through his all-but-incredible camera at the rate of thirty-six miles a minute.

In other words, it begins to look as if the year just past, and that to come, would go down in photographic history as the greatest since the cat in the laboratory of the pioneer, Daguerre, upset a bottle of chemical and, leading to his accidental discovery of photography, started the whole business.

LABORATORY REVEALS SECRETS OF FLIGHT

(Continued from page 90)

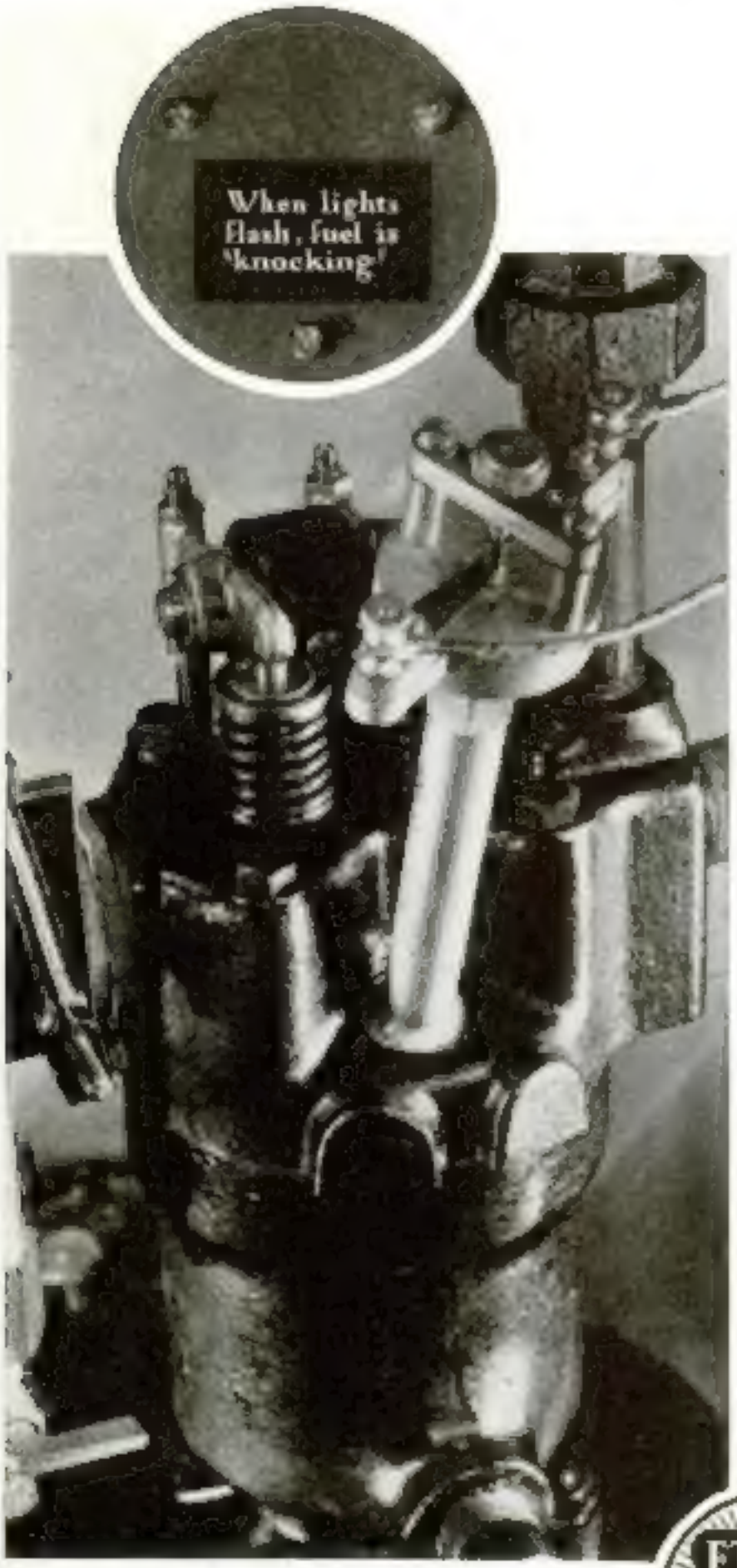
field showed that of all the drag which an airplane must overcome to remain in the air, 49.6 percent was caused by the wings and struts, 4.7 percent by the tail surfaces, 13.4 percent by the landing gear, 16.9 percent by the engine, and 15.4 percent by the fuselage. Drag of the wings, struts, tail, and fuselage are necessary; the problem was to conquer that of other parts of the plane.

The engine cowling has greatly reduced engine drag. Experiments are now under way that promise to reduce landing gear drag. In one case, the committee's engineers designed a support for holding airplanes in the propeller research tunnel which falls far below the present day landing gear in the drag it offers.

On the other hand, safety is a problem that the N. A. C. A. is attacking with characteristic thoroughness. Much of its present research is being directed toward increasing stability and control of airplanes in all conditions of flight, especially at stalling speeds, when the deadly tail spin begins.

Wing designs are being modified and tested both in wind tunnels and between earth and sky. Wing slots, flaps, floating ailerons, and other appliances are being designed and put through exhaustive tests. Radically designed planes, such as the McDonnell "Doodlebug," are being tried out.

This PIN *tells fortunes for* Gasoline



The Bouncing Pin forms an electrical contact that flashes the light above whenever gasoline is not exploding evenly. It does not flash this warning signal when the fuel is Ethyl Gasoline. Ethyl fluid prevents uneven explosions.

THE Bouncing Pin, it is called: because it bounces on the breaking point of gasoline efficiency.

Ordinary gasoline has a tendency to explode too quickly under the strain of cylinder pressure; causing power-waste, overheating, and causing in its worst form the banging impact of gas against cylinder walls that you call "knocking."

The Bouncing Pin detects power-wasting explosions even before they are bad enough to cause audible "knocking."

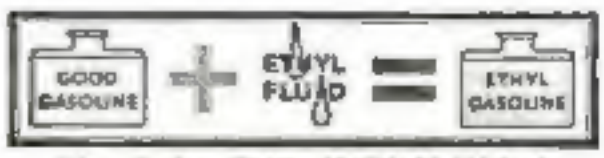
Before any gasoline is mixed with Ethyl fluid it comes to the Bouncing Pin to have its fortune told—to find how much Ethyl fluid is needed in each gallon to prevent shattering explosions under the strain of high pressure.

At the same time the gasoline is tested in other machines for purity, quick-starting, and other desirable qualities. Then, after Ethyl fluid has been added to this good gasoline in needed quantity, it comes back to the Bouncing Pin to make sure combustion goes forward with the smoothly increasing pressure that enables Ethyl Gasoline to bring out the best performance of any motor.

Ninety-six leading oil refiners now take advantage of the combustion control that Ethyl fluid gives to good gasoline. You will find their products for sale at pumps all over the country. Every Ethyl Gasoline pump is marked with the Ethyl emblem.

In your car, Ethyl Gasoline will give you greater power, with less overheating, and no "knocking." It will cause less wear and tear on the motor and give you smoother, quieter performance because its combustion is controlled. Ethyl Gasoline Corporation, Chrysler Building, New York City.

ETHYL



The active ingredient used in Ethyl fluid is lead.

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Awake *and Away* *with the* Face *that's* Fit

TOP OF THE MORNING to you . . . to every man whose Face is Fit. Awake and away . . . out into a world where face value counts. Clear-complexioned, smooth-shaven, the executive looks the part. And "the part" begins with Williams Shaving Service. The quick and easy way to keep your face fit.

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Now Aqua Velva. Cup your hand . . . pour it in . . . dash it all over your face. It's bracy. It's tingly. With a hint of outdoor fragrance that you'll like. Friendly, too. For Aqua Velva helps to care for unseen nicks and cuts . . . tones and protects the skin . . . conserves the natural moisture . . . keeps your face fresh as the morning throughout the livelong day.

That's Williams Shaving Service. Good grooming for the man who's awake and away. Try it and see!

» *Have you tried Williams Shaving Liquid? Very quick, very cool, very new. Ask your dealer!*

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I am anxious to try Williams Shaving Service. Please send me trial sizes of Williams Shaving Cream and Aqua Velva.

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CAMEL-LIGHTING TIME

SOFT LIGHTS and friendly shadows, intimate, alluring—and the mellow contentment of a Camel!

The pleasure of *any* moment is heightened by Camel's fresh, cool fragrance, tingling with the delicate aromas of the world's choicest tobaccos—sun-ripened—naturally mild.

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